OUR HEADQUARTERS.

1843–1900.

Shapleigh's Hand Book

CONTAINING INFORMATION FOR HARDWARE MEN, MECHANICS AND ARTISANS. COMPILED FOR THE CONVENIENCE OF OUR VALUED PATRONS,

— BY —

NILE C. SMITH.

1900

A. F. SHAPLEIGH HARDWARE COMPANY,

ST. LOUIS, MO.

⚜ Introductory. ⚜

IN compiling this book we have endeavored to make the most useful and valuable selections from leading works, and the entire contents has been selected and arranged with the idea of supplying information of a character which it is thought will be appreciated by our valued patrons.

Every effort has been made to present the contents in a trustworthy and convenient form, and we hope the labor and expense involved will be fully compensated for by the book proving sufficiently useful to our trade.

We desire to thank those manufacturers who have kindly supplied us with valuable information which was unobtainable elsewhere.

Appended will be found a display advertisement of a few leading firms, in some of the principal lines we carry, and as the selection has been made with considerable care, we can guarantee satisfaction to all of our friends who place orders for their lines with us.

A. F. SHAPLEIGH HARDWARE CO.

ALPHABETICAL INDEX.

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Practical Suggestions, Standard Rules, Etc., Concerning the Use and Care of Circular Saws.

HANGING THE SAW.

Before placing the new saw upon the mandrel, be sure that the side so marked comes next to the log on your mill; if it does not, it should be sent to the factory to be hammered so as to suit your mill.

Be sure that the mandrel is level, and that the saw when placed on it and the flanges screwed up, is perfectly plumb. The holes in the saw should be an easy fit on the mandrel and lug pins.

Be sure that it does not bind on the mandrel or the pins. If it does, the least warmth of the mandrel will be sure to cause it to expand, bind and spring the saw.

It should slip on readily, neither tight nor loose.

Saws are often pronounced crooked when the fault is in the collars.

If the position or "dish" of the saw is changed in the least by tightening the collars for work, the defect should be remedied at once. Put a straight-edge on the log side of the saw, and ascertain whether the fault is in the saw or in the collars.

Thin saws, and saws of high speed, are put up very open so that the center will pull through, and the saw, when hung on the mandrel, may show concave or convex on the log side when standing still, but when run up to the speed for which it is hammered, it should straighten up and be flat, or nearly so, on the log side.

When hung upon the mandrel and the collars tightened, the saw should be perfectly round, so that every tooth will do its proper work. Should the saw be too crowning or too dishing on the log side, the difficulty may be overcome by papering between the saw and the collars. If the saw is dished on the log side, cut a ring of paper of the size of the collar and about three-fourths inch wide: wet it with oil and lay it on the loose collar.

Cut a smaller ring of paper of the same width to fit the mandrel, and place it on the mandrel against the fast collar. If one thickness of paper is not sufficient, add another ring, and so on until the saw, when clamped between the flanges, is brought to the proper position.

Should the saw be too crowning on the log side, reverse the position of the paper rings, placing the large one next the fast collar and the smaller one next the loose collar. Letter paper for making the rings is preferable, being solid and firm.

LINING THE SAW WITH THE TRACK.

Take all of the end play out of the mandrel. Run the carriage up past the saw so that one of the head-blocks will be opposite the center of the saw. Fasten a square piece of board on the head-block and let the end of the board touch the face of the saw at its center. Then run the carriage back from the front of the saw 20 feet. Draw a line from the end of the board past the saw parallel with the track. The line where it passes the center of the saw should be from one-eighth inch to one-fourth inch from the face of the saw. This would show the track at 20 feet from the center of the saw on a line with the saw, and that the track at the center of the saw, if put down right, is one-eighth inch to one-fourth inch further off from the saw than at 20 feet distant.

Some saws require more inclination toward the track than others, and the track being adjusted properly, any small variation required may be accomplished by means of the set screws on the box.

The track should be solid, level and perfectly straight, and the saw frame firmly anchored. Trouble is often caused by a neglect to keep the track in order, and it should be examined frequently.

LEAD.

We have shown that the lead of the saw to the log may be adjusted by its position to the track. It may be held to its work in the log by beveled filing on the back of the tooth. The teeth, if properly filed, should always be perfectly square on the front side, but if the saw tends to lead in or out of the log, it may be held to the proper position by beveling the back side of the tooth at the point. If the front of the tooth is filed perfectly square and the teeth are beveled on the back, on the broad side, this will lead your saw into the log, or, if you bevel on the log side, it will lead the saw out of the log.

Should the saw lead in and out, or what is called "snaky," it is evident that it needs hammering, that the rim is too large for the center, and the saw needs opening out at the center. Such a saw may be run warm at the center and the difficulty overcome in this way; otherwise it will require hammering.

POINTS TO BE OBSERVED.

See that the track is solid, level and straight; that saw shaft is level and the saw hangs plumb; that it goes on the mandrel easy, is a close fit, and that the lug pins have a bearing; that the tight collar is a little concave and the loose one perfectly flat; that the saw is straight on the log side when

the collars are screwed up and the saw run up to the required speed; that it is in line with the carriage and a little inclined toward the log; that the saw is perfectly round and has throat-room sufficient for the dust; that the teeth are not too high on the back side; that the teeth are filed perfectly square on the front side, and swaged sufficient to give clearance for the body of the saw; that there is very little, if any, end play to the mandrel; that the guides are perfectly adjusted when the saw is standing still.

Do not try to lead the saw with the guide pins, but lead the saw by adjusting it properly to the track and by proper filing. If you wish the saw to run warm at the center, you can create friction by reducing the set or spread of the teeth. If the saw heats too much in the center, give it a little more set. If the saw heats on the rim it is because the teeth have not sufficient throat-room for clearance of the dust, or the backs of the teeth are too high. If the saw is too tight on the rim increase the motion if possible, and be sure to keep it cool in the center.

The saw should be run at uniform speed both in and out of the cut.

If the guide pins are run too close, the saw will heat at the rim and run "snaky." If gum is allowed to collect on the sides of the saw, the rim will heat from the friction.

TRUEING SAW ON THE MANDREL.

If the saw is in proper tension and does not run true, take all the end play out of the mandrel; rest a small piece of board with one end sharpened, upon the saw frame; hold the sharpened end against the board side of the saw near the rim. Mark with chalk the high places or those that touch, and on the opposite side the hollow places or those which do not touch the board. Turn the saw so as to bring the high points directly over the arbor, and, with a sharp pull bend the points which are high on the board side toward you, and with a sharp push bend the parts which are high on the log side from you. By testing and bending in this way you may make a saw run perfectly true on the mandrel which has been sprung or does not from any cause run true.

CAUSES FOR HEATING ON THE RIM.

Guide pins set too close.
Teeth have not enough spread or set.
Backs of the teeth too high.
Not throat-room enough for saw dust.
Accumulation of gum on the teeth.
Saw not open enough in the body for the speed.

CAUSES OF HEATING AT CENTER.

Teeth have not enough spread or set.
Saw lined too much out of log.
Mandrel runs too warm.
Saw too open in the body or center for the speed.
Speed not sufficient to expand the rim.
Saw dished too much to or from the log.

POINTS TO BE OBSERVED IN ORDERING SAWS.

In ordering a circular saw, the kind of work to be done and the power at hand to drive it, should always be taken into account.

GAUGE OF SAW.

For mills of ordinary capacity, doing general work, we recommend saws seven gauge at the center, and eight on the rim. If the timber is valuable and the sawyer skillful, an eight by nine gauge may be used and in special cases an eight by ten gauge. Any lighter gauge than eight at the center and ten at the rim is considered impracticable for use in ordinary mills. A trial of very thin saws as an economical means, will in most cases, be followed by disappointment, for greater than ordinary skill is necessary to successfully manage thin saws, and the lumber saved by the reduced thickness of the saw is more than offset by the waste by bad cuts, where the sawyer is not an expert.

The greater the speed and feed used, the heavier the saw should be to stand up to the work, hence it is that for the large mills, where the saving of time more than lumber is desired, saws of six and seven gauge are mostly in demand.

NUMBER OF TEETH.

With a high motion more teeth are required, for high feed follows great speed, and the saw having more work to do should have more teeth with which to do it, in order that the strain may be evenly distributed.

The number of teeth, therefore, should depend not alone on the thickness of the saw, but on the kind of timber to be sawed, and the speed and feed of the mill.

Having considered these matters, orders for circular saws should be accompanied by the following:

INSTRUCTIONS FOR ORDERING CIRCULAR SAWS.

When ordering circular saws, the following directions should be explicitly given:

Diameter of saw in inches; right or left hand; thickness or gauge of saw at rim; thickness or gauge of saw at center; number of teeth in saw; kind of tooth; size of mandrel hole; size of pin holes; distance between pin holes from center to center; number of revolutions per minute; greatest feed at each revolution of saw, in inches; kind of lumber to be sawed; spring set or swage; whether for ripping or cross-cutting. When ordering bolting saws, state whether rip or cross-cut.

Standing in front of a circular saw, with the saw revolving toward you, if the log passes to the right of the saw it is a right-hand saw; if to the left, it is a left-hand saw.

Saws run horizontally (such as shingle saws) are *right*-hand when revolving from left to right (against the sun), or as you turn a right-hand screw thread to unscrew it. They are *left*-hand when revolving from right to left (with the sun), or as you turn a right-hand screw thread to tighten it.

TABLE OF SPEED OF CIRCULAR SAWS.

Size of Saw. Inches.	Rev. per Minute.	Size of Saw. Inches.	Rev. per Minute.
8	4,500	42	870
10	3,600	44	840
12	3,000	46	800
14	2,585	48	750
16	2,222	50	725
18	2,000	52	700
20	1,800	54	675
22	1,636	56	650
24	1,500	58	625
26	1,384	60	600
28	1,285	62	575
30	1,200	64	550
32	1,120	66	545
34	1,050	68	529
36	1,000	70	514
38	950	72	500
40	900		

The above table is figured on a periphery speed of 9,000 feet per minute, but saws for portable mills are usually run at a speed of about 450 revolutions per minute, and saws for steam feed mills, from 600 to 900 revolutions per minute.

THE MOTION OF CIRCULAR SAWS.

This is one of the most essential things to be observed, and no one can give this too much attention. If the speed of the saw is too high, it cannot do good work, besides rendering it liable to many accidents. It generates heat in the saw, makes it touchy and limber, and it will only run and do good work on light feed, and while the teeth are in the best of order, and have a keen, sharp, cutting corner; as soon as this is gone, the saw will run or dodge whenever it comes in contact with the least obstacle. And again: Too low has its objections, but it is not attended with such ruinous effects upon the saw. These difficulties can be remedied to a limited extent by the hammering of the saw, but cannot be entirely overcome.

RULES FOR CALCULATING THE SPEED OF SAWS, PULLEYS OR DRUMS.

PROBLEM 1. The diameter of the driven being given, to find its number of revolutions.

RULE.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions of the driven.

PROBLEM 2. The diameter and revolutions of the driver being given, to find the diameter of the driven, that shall make any given number of revolutions in the same time.

RULE.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the number of revolutions of the driven; the quotient will be its diameter.

PROBLEM 3. To ascertain the size of the driver.

RULE.—Multiply the diameter of the driven by the number of revolutions you wish it to make, and divide the product by the revolutions of the driver; the quotient will be the size of the driver.

GENERAL HINTS RESPECTING THE MANNER OF FITTING OR DRESSING SAWS.

A saw tooth should have the proper spread and pitch for the wood which it is to cut. Soft wood requires more spread or "set," and less pitch; hard wood the reverse. A saw swaged full on both corners with square dress will do the fastest cutting, but requires the most power. In swaging use oil on point of tooth.

By careless dressing we have seen saw teeth higher back of the cutting point than at the point itself, thereby causing the saw to bind and heat on the rim.

The greater the feed the lower the back of the tooth should be, giving easier clearance and greater dust room.

1. *Safety Valves.*—Great care should be exercised to see that these valves are ample in size and in working order. Overloading or neglect frequently lead to the most disastrous results. Safety valves should be tried at least once a day to see if they will act properly.

2. *Pressure Gauge.*—The steam-gauge should stand at zero when the pressure is off, and it should show same pressure as the safety valve when the latter is blowing off. If not, then one is wrong, and the gauge should be tested by one known to be correct.

3. *Water Level.*—The first duty of an engineer before starting is to see that the water is at the proper height. Do not rely on glass gauges, floats or water alarms, but try the gauge-cocks.

4. *Gauge-Cocks and Water-Gauges.*—Both must be kept clean. Water-gauges should be blown out frequently, and the glasses and passages to gauge kept clean.

5. *Feed-Pump or Injector.*—These should be kept in perfect order, and of ample size. No make of pump can be expected to be continuously reliable without regular and careful attention. It is always safe to have two means of feeding the boiler. Check-valves and self-acting feed-valves should be frequently examined and cleaned. Satisfy yourself that the valve is acting when the feed-pump is at work.

6. *Low Water.*—In case of low water immediately cover the fire with ashes (wet if possible) or any earth that may be at hand. If nothing else is handy use fresh coal. Draw fire as soon as it can be done without increasing the heat. *Neither turn on the feed, start or stop engine, or lift safety-valve until fires are out and the boiler cooled down.*

7. *Blister and Cracks.*—These are liable to occur in the best plate iron or steel. When first indications appear, there must be no delay in having it examined and carefully cared for.

8. *Fusible Plugs.*—When used, must be examined when the boiler is cleaned, and carefully scraped clean on both water and fire sides, or they are liable not to act.

9. *Firing.* Charge evenly and regularly, a little at a time. Moderately thick fires are most economical, but thin firing must be used when draught is poor. Take care to keep the grates evenly covered, and allow no air-holes in the fire. Be especially careful to lay the coal along the sides and in the corners. All lumps should be broken into the size of a man's fist. With bituminous coal, a "coking fire" (that is, firing in front, and then shoving the coal back when it is coked), gives the best result. Do not "clean" fires oftener than necessary. The

cleaning of the fire is best done, in ordinary working, by a "rake," or other tool, working on the under side of the grate, and not by a "slice-bar," driven in the mass of fuel *above* the grates.

10. *Cleaning.*—All heating surfaces must be kept clean, outside and in, or there will be serious waste of fuel. The frequency of cleaning will depend on the nature of the fuel and water. As a rule never allow over one-sixteenth inch scales or soot to collect on surfaces between cleanings. Hand holes should be frequently removed and surfaces examined, particularly in case of a new boiler, until proper intervals between cleanings have been established by experience. Examine mud-drums and remove sediment therefrom.

11. *Hot Water Feed*—Cold water should never be fed into a boiler if it can be avoided, but when necessary, it should be caused to mix with the heated water before coming in contact with any portion of the boiler.

12. *Foaming.*—When foaming occurs in a boiler, checking the outflow of the steam will usually stop it. If caused by dirty water, blowing down and pumping up will generally cure it. In cases of violent foaming, check the draught and cover the fires.

13. *Air Leaks.*—Be sure that all openings for admission of air to boiler or flue, except through the fire, be carefully stopped. This is often an unsuspected cause of serious waste.

14. *Blowing Off.*—If feed-water is muddy or salt, blow off a portion often, according to the condition of the water. Empty the boiler every week or two, and fill up fresh. When surface blow-cocks are used, they should be often opened for a few minutes at a time. Make sure no water is escaping from the blow-off cock when it is supposed to be closed. Blow-off cocks and check-valves should be examined every time the boiler is cleaned.

15. *Leaks.*—Repair leaks as soon as possible after discovered.

16. *Emptying Boiler.*—Never empty the boiler while the brick-work is hot.

17. *Rapid Firing.*—Don't indulge in rapid firing. Steam should be raised slowly from a cold boiler.

18. *Standing Unused.*—If a boiler is not required for some time, empty and dry it thoroughly. If this is impractical, fill it quite full of water, and put in a quantity of common washing soda.

19. *General Cleanliness.*—All things about the boiler-room should be kept clean and in good order. Negligence tends to waste and decay.

STEAM FOR HEATING.

In estimating for steam-heating, allow one square foot of boiler surface for each ten square feet of radiating surface. Small boilers should be larger proportionately than large boilers.

Each horse-power of boiler will supply from 250 to 350 feet of 1 inch pipe, or 80 to 120 square feet of radiating surface.

Under ordinary circumstances, one horse-power will heat about as follows:

Brick buildings in blocks	15,000 to 20,000	cubic feet.
Brick stores in blocks	10,000 to 15,000	" "
Brick dwellings, exposed, all sides	10,000 to 15,000	" "
Brick mills, shops, etc	7,000 to 10,000	" "
Wooden buildings, exposed	7,000 to 10,000	" "
Foundries and wooden shops	6,000 to 10,000	" "

It is, of course, but good workmanship to make *all* the joints steam and water tight, as the slightest leak in a steam-heating system is apt to do considerable damage to furniture, curtains, carpets, etc., if the steam is intended to heat a dwelling. Red or white lead is all right as material to make up joints, but graphite is much better. For gaskets there is nothing better than asbestos, and this material is now manufactured into gasket rings, cut true to size, making asbestos gaskets not only the best, but furnished in a convenient form which will be highly appreciated by the steam-fitter.

The quality of rubber sheets sold by dealers for gaskets, is sometimes of the poorest order, and rubber in any form, vulcanized or otherwise, is poor stuff to put in contact with steam. Gaskets made of thin lead are good, and first-class packing can be made of candle wicking and ordinary resin soap, but asbestos is the best.

POINTS ON BOILER'S CIRCUMFERENCE.

In text-books we have the areas and circumferences of circles, but if we don't know how to use them, they are of no use to us. They are all right for tin or any thin stuff, but not for boiler-makers. As an instance, supposing we have a boiler to make 36″ diameter. If we look at the table of circumference we will find that it takes 113.098″—one hundred and thirteen inches and about one-sixteenth. This would not give either side or outside diameter, but would be the thickness of iron, less, if we were wanting inside measurement, or more, if for outside diameter. If the shell is of ¼″ material we must add the ¼″ to the diameter for inside diameter, making it 36¼″. For this we will find that it takes 113.883″ or a little over ⅞ of an inch more, and for outside diameter we must take off the thickness of material,

making the diameter 35¾″. For this it would take 112.312″, or about 113¼, as near as can be got by the common rule. There are several ways for figuring this. A good plan is to multiply the diameter by three, and divide the same by seven, and add the product together. But it must be understood that neither this or the taking from tables in text-books give laps. In working this rule, three times 36¼ is 108¾, and 7 into 36 will go five times and 1/7 over, but instead of calling it 1/7 call it ⅛, and we have it on the rule. For the small course there is a difference of six and one-half times the thickness of material. This will hold good in all cases, so that if we get one course out by figuring, the other may be got by adding or subtracting this difference. As in the majority of men, they have a holy horror of figures, especially boiler-makers, in "manufactories." Another thing that is not generally understood among them is the properties of a circle. A circular vessel will contain a greater quantity than a vessel of any other shape, made of the same amount of material. That is to say, if an iron plate, six feet long, was rolled to a circle and a bottom put in it, it would hold more water than if it was bent square or any other shape. The areas of circles are to each other as the squares of their diameters. Any circle twice the diameter of another, is also four times its area and twice its circumference. The diameter of a circle is a straight line drawn through its center, touching both sides. The radius of a circle is half the diameter, or the distance from the center to the circumference.

HOW TO GEAR A LATHE FOR SCREW CUTTING.

There is a long screw upon every screw-cutting lathe, called the lead-screw. This lead-screw feeds the carriage of the lathe while cutting screws, and has a gear wheel placed upon its end which takes motion from another gear wheel attached on the end of the spindle. Each of these gear wheels contain a different number of teeth, so that different threads may be cut. All threads are cut a certain number to the inch, from one to fifty or more. In order to gear your lathe properly to cut a certain number of threads to the inch, you will first multiply the number of threads to the inch you wish to cut by 4, or any other small number, and this will give you the proper gear to put on the lead-screw. Now, with the same number, 4, multiply the number of threads to the inch in the lead-screw, and this will give you the proper gear to put on the spindle.

Example.—You wish to cut a screw with ten threads to the inch. Multiply 10 by 4 and it will give you 40; put this gear on the lead-screw. The lead-screw on your lathe has 7 threads to the inch; multiply 7 by 4, and you will have 28. Put this gear

on your spindle, and your lathe is geared to cut 10 threads to the inch.

The rule above is for those lathes which have not a stud grooved into the spindle. As this stud runs with but half the speed of the spindle, you must change the rule somewhat. First, multiply the number of threads to the inch you wish to cut, by 4 (or some other small number), and this will give you the proper gear to put on your lead-screw. Next multiply the number of threads to the inch on your lead-screw by the same number, and *multiply this product by 2*, and this will give you the proper gear to go on your stud.

Example.—Using same numbers—10 times 4 is 40. Put this gear on your lead-screw; 7 times 4 is 28, and 2 times 28 is 56; put this gear on your stud, and your lathe is grooved to cut 10 threads to the inch.

HOW TO MAKE A STRONG FLANGE JOINT.

To make a flange joint that won't leak or burn out on steam pipes, mix two parts white lead to one part red lead to a stiff putty; spread on the flange evenly, and cut a liner of gauze wire—like mosquito net wire—and lay on the putty, of course cutting out the proper holes; then bring the flanges "fair," put in the bolts and turn the nuts on evenly. For a permanent joint this is A 1.

HOW TO THAW OUT A FROZEN STEAM PIPE.

A good way to thaw out a frozen-up steam pipe, is to take some old cloth, discarded clothes, waste, old carpet, or anything of that kind, and lay on the pipe to be thawed; then get some good hot water and pour it on. The cloth will hold the heat on the pipe, and thaw it out in five minutes. This holds good in any kind of a freeze, water-wheel, or anything else.

THE PREVENTION OF ACCIDENTS FROM RUNNING MACHINERY.

A German commission was appointed to investigate accidents in mills and factories, and draw up a series of rules for their prevention. Some of these rules are as follows:

SHAFTING.

All work on transmissions, especially the cleaning and lubricating of shafts, bearings and pulleys, as well as the binding, lacing, shipping and unshipping of belts, must be performed only by men especially instructed in, or charged with, such work. Females and boys are not permitted to do this work.

The lacing, binding or packing of belts, if they lie upon either shaft or pulleys during the operation, must be strictly prohibited. During the lacing and connecting of belts, strict attention is to be paid to their removal from revolving parts, either by hanging them upon a hook fastened to the ceiling, or in any other practical manner; the same applies to smaller belts, which are occasionally unshipped and run idle.

While the shafts are in motion, they are to be lubricated, or the lubricating devices examined only when observing the following rules: *a.* The person performing this labor must either do it while standing upon the floor, or by the use of *b.* Firmly located stands or steps, especially constructed for the purpose, so as to afford a good and substantial footing to the workman. *c.* Firmly constructed sliding ladders, running on bars. *d.* Sufficiently high and strong ladders, especially constructed for this purpose, which, by appropriate safeguards (hooks above or iron points below), afford security against slipping.

The cleaning and dusting of shafts, as well as of belt or rope pulleys mounted upon them, is to be performed only when they are in motion, either while the workman is standing: *a*, on the floor; or *b*, on a substantially constructed stage or steps; in either case, moreover, only by the use of suitable cleaning implements (duster, brush, etc.), provided with a handle of suitable length. The cleaning of shaft bearings, which can be done either while standing upon the floor or by the use of the safeguards mentioned above, must be done only by the use of long-handled implements. The cleaning of the shafts, while in motion, with cleaning waste or rags held in the hand, is to be strictly prohibited.

All shaft-bearings are to be provided with automatic lubricating apparatus.

Only after the engineer has given the well understood signal, plainly audible in the work-rooms, is the motive engine to be started. A similar signal shall also be given to a certain number of work-rooms, if only their part of the machinery is to be set in motion.

If any work other than the lubricating and cleaning of the shafting is to be performed while the motive engine is standing idle, the engineer is to be notified of it, and in what room or place such work is going on, and he must then allow the engine to remain idle until he has been informed by proper parties that the work is finished.

Plainly visible and easily accessible alarm apparatus shall be located at proper places in the work-rooms, to be used in cases of accident to signal to the engineer to stop the motive engine at once. This alarm apparatus shall always be in

working order, and of such a nature that a plainly audible and easily understood alarm can at once be sent to the engineer in charge.

All projecting wedges, keys, set-screws, nuts, grooves, or other parts of machinery, having sharp edges, shall be substantially covered.

All belts and ropes which pass from the shafting of one story to that of another shall be guarded by fencing or casing of wood, sheet-iron or wire netting four feet six inches high.

The belts passing from shafting in the story underneath and actuating machinery in the room overhead, thereby passing through the ceiling, must be inclosed with proper casing or netting corresponding in height from the floor to the construction of the machine. When the construction of the machine does not admit of the introduction of casing, then, at least, the opening in the floor through which the rope or belt passes should be inclosed with a low casing at least four inches high.

Fixed shafts, as well as ordinary shafts, pulleys and fly-wheels, running at a little height above the floor, and being within the locality where work is performed, should be securely covered.

These rules and regulations, intended as preventions of accidents to workmen, are to be made known by being conspicuously posted in all localities where labor is performed.

ENGINEERS.

The attendant of a motive engine is responsible for the preservation and cleaning of the engine, as well as the floor of the engine-room. The minute inspection and lubrication of the several parts of the engine is to be done before it is set in motion. If any irregularities are observed during the performance of the engine, it is to be stopped at once, and the proper person informed of the reason.

The tightening of wedges, keys, nuts, etc., of revolving or working parts, is to be avoided as much as possible during the motion of the engine.

When large motive engines are required to be turned over the dead point by manual labor, the steam supply valve is to be shut off.

After stoppage, either for rest or other cause, the engine is to be started only after a well-understood and plainly audible signal has been given. The engineer must stop his engine at once upon receipt of an alarm signal.

The engineer has the efficient illumination of the engine-room, and especially the parts moved by the engine, under his charge.

The engineer must strictly forbid the entrance of unauthorized persons into the engine-room.

An attendant of a steam or other power motor, who is charged with the supervision of the engine as his only duty, is permitted to leave his post only after he has turned the care of the engine over to the person relieving him in the discharge of his duties.

The engineer is charged with the proper preservation of his engine, and means therefor. He must at once inform his superior of any defect noticed by him.

The engineer on duty is permitted only to wear closely fitting and buttoned garments. The wearing of aprons or neckties with loose, fluttering ends, is strictly prohibited.

GEARING.

Every work on gearing, such as cleaning and lubricating shafts, bearings, journals, pulleys and belts, as well as the tying, lacing and shipping of the latter, is to be performed only by persons either skilled in such work, or charged with doing it. Females and children are absolutely prohibited from doing such work.

When lacing, binding or repairing the belts, they must either be taken down altogether from the revolving shafts or pulley, or be kept clear of them in an appropriate manner. Belts unshipped for other reasons are to be treated in the same manner.

The lubricating of bearings and the inspection of lubricating apparatus must, when the shafting is in motion, be performed either while standing upon the floor or by the use of steps or ladders, specially adapted for this purpose, or proper staging or sliding ladders. The lubrication of wheel work and the greasing of belts and ropes with solid lubricants is absolutely prohibited during the motion of the parts.

In case of accident, any workman is authorized to sound the alarm signal at once by the use of the apparatus located in the room for this purpose, to the engineer in charge.

The following rules, classified under proper sub-heads, are published in the *Technische Verein*, at Augsburg:

TO PREVENT ACCIDENT BY THE SHAFTING.

While the shafts are in motion, it is strictly prohibited: *a.* To approach them with waste or rags, in order to clean them. *b.* In order to clean them, to raise above the floor by means of a ladder or other convenience.

It is allowable to clean the shafting and pulleys only while in motion.

These parts of the machinery must be cleaned by means of a long-handled brush only, and while standing upon the floor.

The workmen charged with these or other functions about the shafting must wear jackets with tight sleeves, and closely

buttoned up; they must wear neither aprons nor neckties with loose ends.

Driving pulleys, couplings and bearings are to be cleaned only when at rest.

This labor should, in general, be performed only after the close of the day's work. If performed during the time of an accidental idleness of the machinery, or during the time of rest, or in the morning before the commencement of work, the engineer in charge is to be informed.

HOW TO FIND THE HORSE-POWER OF AN ENGINE.

Multiply the square of the diameter of the cylinder by 0.7854, and, if the cut-off is not known, multiply the product by four-fifths of the boiler pressure; multiply the last product by the speed of the piston in feet per minute (or twice the stroke in feet and decimals, multiplied by the revolutions per minute). Divide the final product by 33,000, and the horse-power will be the answer.

USEFUL CEMENTS.

A cement said to resist petroleum is made by taking three parts resin, one part caustic soda to five of water, boiled together, the resin being melted first, of course. This makes a resin soap, to which must be added half its weight of plaster. It hardens in forty minutes. Useful for uniting lamp tops to glass. Glycerine and litharge, mixed thoroughly, is said to form a cement which hardens rapidly, and will join iron to iron or iron to stone. Not affected by water or acids.

A cement for leaky roofs is made by the following articles in the proportions named: 4 pounds resin, 1 pint linseed oil, 2 ounces red lead; stir in finest white sand until of the proper consistency, and apply hot. It possesses elasticity, and is fireproof.

Starch and chloride of zinc form a cement which hardens quickly, and is durable. Sometimes used for stopping blow-holes in castings.

A cement for uniting metal to glass is made with 2 ounces thick solution of glue, 1 ounce linseed oil varnish. Stir and boil thoroughly. The pieces should be tied together for three days.

A cement of 100 parts each white sand, litharge and limestone, combined with 7 parts of linseed oil, makes the strongest mineral cement known. At first the mass is soft and of little coherence, but in six months' time it will, if pressed, become so hard as to strike fire from steel.

A free application of soft soap to a fresh burn almost instantly removes the fire from the flesh. If the injury is very

severe, as soon as the pain ceases apply linseed oil, and then dust over with fine flour. When this covering dries hard, repeat the oil and flour dressing until a good coating is obtained. When the latter dries, allow it to stand until it cracks and falls off, as it will in a day or two, and a new skin will be found to have formed where the skin was burned.

RULES FOR THE FIREMAN.

In the care and management of the steam boiler the first thing required is an unceasing watchfulness—*watch-care* is the very word which describes it. The accidents arising from neglect or incompetency in care of the engine are few and unimportant compared to those which come from negligence in attending the boiler.

Hence the fireman needs to be a man possessed of some of the highest qualities of manhood. The fact that many of the best steam engineers in the country have begun their careers by handling the shovel is evidence that good men are required and employed in this capacity, and that they are rewarded for their faithfulness by advancement.

An intemperate, reckless or indifferent man should never be given this place of trust. The sooner a man is dismissed who is either of these the better, both for himself and his employers, to say nothing of the innocent and unsuspecting public.

An employer should know something of the character and habits of the man who does the firing. A daily visit, and, at irregular times, with an eye to things in *the boiler-room,* as well as the engine-room, will keep him posted, to his great advantage. This regular inspection is most welcome to faithful and careful men, and is a great inspiration to good service. A steam-user should visit his steam department as regularly as he does his office, although he may not spend as much time there. The failure of scores of otherwise flourishing establishments is due to waste and recklessness in the use of fuel under the boilers, or the heavy losses incurred by repairs and explosions—by which the whole business is stopped while the expenses continue undiminished.

A feeling of conscientious responsibility should be the uppermost thing upon the mind of a fireman when on duty. He should consider and know how to figure the total tons of pressure upon the plates of his boiler, and have constantly in mind the importance of using unceasing vigilance.

To know how to be a good fireman cannot be taught by a book. The knowledge comes by experience and by instruction of engineers who have themselves been good firemen, but the

following are some of the hints and rules which may be of advantage to the new beginner.

First—The fireman should be a sober and temperate person. Frivolous or reckless conduct about a steam boiler is entirely out of place, and should not be permitted. There is too much danger and too much cost—not to call it waste—of fuel to allow any indifference or recklessness in the man upon whom so many depend.

Second—The fireman should be punctual in beginning his work. A loss of five minutes in starting into vigorous activity the men and machines of an establishment is sometimes caused by inattention of the fireman, and the blame which is showered upon him is a stern reminder that he is held accountable for the loss.

Third—A habit of neatness is an almost necessary quality, and which pays better for the cost of investment than any other.

Fourth—The tools should be kept in their places, and in good order.

Fifth—The boiler and all its attachments should be kept in the very tidiest and attractive condition possible.

Sixth—The fireman, notwithstanding its apparent difficulty, should keep himself—as said once—"respectable about his work." Scattered coal and ashes and dripping oil should be constantly cleaned up, and every effort made to make the boiler-room an attractive and cheerful place.

Seventh—The fireman needs to know all the details of his work, and to do with exactness every duty imposed upon him. He needs to be cool and brave in the presence of unexpected conditions, such as sudden leaks, breakages of the glass gauges and sudden stoppages of the engine with a heavy head of steam on.

Eighth—He should have an idea of the importance of his work, and keep in mind to learn to do everything that may fit him in time for an advanced position.

THE CARE OF MACHINERY.

The money spent in keeping machinery clean and in order is by no means wasted. The better the machinery, the greater the necessity for proper supervision. The first knock in an engine, the smallest leak in a boiler, the slightest variation from truth in a mill spindle, the wearing down of roller bearings, heating of journals, should be rectified immediately. The smooth and even working of machinery has a great deal to do with the cost of driving, while avoidance of the risk of breakage saves a large sum that would otherwise be spent in repairs.

IMPORTANT TO THOSE OPERATING STEAM BOILERS.

In view of the numerous boiler explosions that have recently occurred, we submit to them the following pertinent questions asked by the *American Machinist*, which should command the careful consideration of every steam user in the land:

How long since you were inside your boiler?

Were any of the braces slack?

Were any of the pins out of the braces?

Did all the braces ring alike?

Did not some of them sound like a fiddle-string?

Did you notice any scale on flues or crown-sheet?

If you did, when do you intend to remove it?

Have you noticed any evidence of bulging in the fire-box plates?

Do you know of any leaky socket bolts?

Are any of the flange joints leaking?

Will your safety valve blow off itself, or does it stick a little sometimes?

Are there any globe valves between the safety valve and the boiler? They should be taken out at once, if there are.

Are there any defective plates anywhere about your boiler?

Is the boiler so set that you can inspect every part of it when necessary?

If not, how can you tell in what conditions the plates are?

Are not some of the lower courses of tubes or flues in your boiler choked with soot or ashes?

Do you absolutely know, of your own knowledge, that your boiler is in safe and economical working order, or do you merely suppose it is?

HOW TO PREVENT ACCIDENTS TO BOILERS.

1st. Carry regular steam pressure.

2d. Start the engine slowly so as not to make a violent change in the condition of the water and steam, and when consistent, stop the engine gradually.

3d. Carry sufficient water in the boiler.

4th. Do not exceed the pressure in pounds per square inch allowed to be carried.

5th. See that every appliance of the boiler, feed pipes and safety-valve, fusible plugs, etc., are in complete working order.

VALUABLE INFORMATION FOR ENGINEERS.

To find the capacity of a cylinder in gallons, multiply the area in inches by the length of stroke in inches, and it will give the total number of cubic inches; divide this by 231, and you will have the capacity in gallons.

The U. S. standard gallon measures 231 cubic inches, and contains 8⅓ pounds of distilled water.

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch.

The average amount of coal used for steam boilers is 12 pounds per hour for each square foot of grate.

The average weight of anthracite coal is 53 pounds to one cubic foot of coal; bituminous, about 48 pounds to the cubic foot.

Locomotives average a consumption of 3,000 gallons of water per 100 miles run.

To determine the circumference of a circle, multiply the diameter by 3.1416.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434, approximately, every foot elevation is equal to ½ pound pressure per square inch, allowing for ordinary friction.

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure that can be exerted. The area of the water piston, multiplied by the pressure of water per square inch gives the resistance. A margin must be made between the power and the resistance to move the pistons at the required speed, from 20 to 40 per cent., according to speed and other conditions.

To determine the diameter of a circle, multiply circumference by .31831.

Steam at atmospheric pressure flows into a vacuum at the rate of about 1550 feet per second, and into the atmosphere at the rate of 650 feet per second.

To determine the area of a circle, multiply the square of diameter by .7854.

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into one cubic foot of steam (approximately).

By doubling the diameter of a pipe, you will increase its capacity four times.

In calculating horse-power of tubular or flue boilers, consider 15 square feet of heating surface equivalent to one nominal horse-power.

RAILWAY GAUGES OF THE WORLD.

Ireland has a standard gauge of 5 ft. 3 in.; Spain and Portugal 5 ft. 6⅛ in.; Sweden and Norway have the 4 ft. 8½ in. gauge over the majority of their railroads, but 20 per cent. of the Swedish roads have other gauges, varying from 2 ft. 7½ in. up to 4 ft.

In Asia, of the British-Indian roads, about 7,450 miles have a gauge of 5 ft. 5⅝ in., the remainder being divided among six gauges from 2 ft. to 4 ft. Of the narrow gauges, the most prevalent, embracing 4,200 miles, is the metre, 3 ft. 3⅜ in.

In Japan, with the exception of an 8-mile piece begun in 1885, with a gauge of 2 ft. 9 in., all the roads have a 3 ft. 6 in. gauge.

In Africa, the Egyptian railroads, amounting to 932 miles, are of the 4 ft. 8½ in. gauge. Algiers and Tunis, with 1,203 miles has the 4 ft. 8½ in. standard on all but 155 miles, which has a 3 ft. 7¼ in. gauge. The English Cape Colony had, in 1885, 1,522 miles, all of 3 ft. 6 in. gauge.

In America, practically the whole of the United States and Canadian railroads are of 4 ft. 8½ in. to 4 ft. 9 in. gauge. In Mexico, in 1884, 2,083 miles were 4 ft. 8½ in., and 944 3 ft. gauge. In Brazil, at the end of 1884, there were 869 miles of 5 ft. 3 in. gauge, and 4,164 miles of various gauges between 2 ft. and 7 in., over 3,700 miles being 1 metre, or 3 ft. 3⅜ in.

In Australia, the different colonies, rather singularly, have different gauges, that of New South Wales being 4 ft. 8½ in., Victoria 5 ft. 3 in., South Australia 4 ft. 3 in. and 3 ft. 6 in., and the other colonies 3 ft. 6 in.

HOW TO OVERCOME VIBRATION.

How to put the smith shop in an upper story without having the working on the anvils jar the building, has been a problem that has frequently given manufacturers trouble. A mechanical engineer says it may be safely done by placing a good heavy foundation of sheet lead on the floor, and on that putting a good thickness of rubber belting.

Another person who is interested in the problem has tried the experiment, with some success, of placing the block, not on the floor, but on the joist direct, making a cement floor up to the block, and over the wooden floor, reaching back beyond the reach of sparks. It is sometimes said that blacksmith shops never burn, but they keep right on burning in spite of theory, and cement floors ought to be helpful in guarding against fires.

TEMPERING STEEL PUNCHES.

Heat your steel to cherry-red, dress out the punch, cut off the point the size of a horseshoe nail, then heat to a cherry-red, immerse it a half inch perpendicularly in the water, then take it out and stand it up perpendicular, clean the end with a piece of grinding stone. When you see the first blue pass over the point, dip it in the water the same depth as before. Clean it again with the stone, and on the appearance of the blue again,

cool it off. The second blue is to make the punch tough. The reason for keeping the punch perpendicular is to allow the atmosphere and the water to cool all sides equally, and to have it cool straight and true.

KEEPING TOOLS.

Keep your tools handy and in good condition. This applies everywhere and in every place, from the smallest shop to the greatest mechanical establishment in the world. Every tool should have its exact place, and should always be kept there when not in use.

Having a chest or any receptacle with a lot of tools thrown into it promiscuously, is just as bad as putting the notes into an organ without regard to their proper place. If a man wants a wrench, chisel or hammer, it's somewhere in the box or chest, or somewhere else, and the search begins. Sometimes it is found—perhaps sharp, perhaps dull, maybe broken.

The habit of throwing every tool down, anyhow, and in any way or any place, is one of the most detestable habits a man can possibly get into. It is only a matter of habit to correct this. Make an inflexible end of your life to "have a place for everything and everything in its place."

It may take a moment more to lay a tool up carefully after using, but the time is more than equalized when you want to use it again, and so it is time saved. Habits, either good or bad, go a long ways in their influence on men's lives, and it is far better to establish and firmly maintain a good habit, even though that habit has no special bearing on the moral character, yet all habits have their influence.

Keeping tools in good order, and ready to use, is as necessary as keeping them in the proper place. To take up a dull saw, or a dull chisel, and try to do any kind of work with it, is worse than pulling a boat with a broom, and it all comes from just the same source as throwing down tools carelessly—habit, nothing more or less. To say you have no time to sharpen is worse than outright lying, for, if you have time to use a dull tool, you have time to put in good order.

STEAM AN INVISIBLE GAS.

How many people, outside of practical men, know that steam is an invisible gas until the moisture it bears is condensed by contact with cold air? Such is a fact, nevertheless, as we may readily see by boiling water in a glass vessel. The bubbles that rise to the surface of the water are apparently empty—the white vapor appears after they burst in the air at the surface of the water.

MESH OF COAL SCREENS.

USED BY THE PRINCIPAL COAL DEALERS

$2^1/_2$, $2^1/_4$ and 2-inch	Screens	Furnace Coal.
$1^3/_4$ and $1^1/_2$ "	"	Stove out of Egg Coal.
$1^1/_4$ and 1 "	"	Nut out of Stove.
$^3/_4$ and $^5/_8$ "	"	Stove Coal.
$^1/_2$ and $^3/_8$ "	"	Nut "
$^1/_4$ "	"	Pea "
$^3/_{16}$ "	"	Brickmakers' Dust.

MESH OF FANNING-MILL WIRE CLOTH.

The ordinary widths are 20, 21, 22 and 24-inch, and the Meshes for cleaning Seed are:

For Wheat	4x4 or 5x5
" Corn and Oats	2x2
" Rye	3x3
" Cockle	8x8 or 9x9
" Peas	2x4 or 2x5
" Clover	13x13 or 14x14
" Clover from Sand	20 or 22 Mesh
" Timothy	16x16, 18x18 or 20x20
" Cheat	2x9, 10 or 12, or 3x10, 11 or 12
" Flax	4x13, 4x14 or 4x16

EMERY WHEELS

TABLE FOR SELECTION OF GRADES.

CLASS OF WORK	No. of Emery or degree of coarseness usually furnished.	Grade Letters or degrees of hardness usually furnished.	Grade Letters or Degrees of Hardness Furnished in Exceptional Cases. Sometimes Soft as	Sometimes Hard as
Large Cast Iron and Steel Castings	16 to 20	P to Q		
Small " " "	20 " 36	O " P	O	U
Large Malleable Iron Castings	16 " 20	Q " R		Q
Small " " "	20 " 30	P " Q	P	W
Chilled Iron Castings	16 " 20	R " T	O	U
Wrought Iron	16 " 30	P " Q	Q	U
Brass and Bronze Castings	20 " 30	O " P	O	R
Rough Work in general	16 " 30	P " Q		R
General Machine Shop use	30 " 46	O " P	O	R
Lathe and Planer Tools	30 " 46	N " O		
Small Tools	46 " 100	N " P	M	P
Wood-Working Tools	36 " 60	M " N		
Twist Drills, (Hand Grinding)	36 " 60	M " N	L	O
" (Special Machines)	46 " 60	G " J		
Reamers, Taps, Milling Cutters, etc., (Hand Grinding)	46 " 100	N " P		
Reamers, Taps Milling Cutters, etc., (Special Machines)	46 " 60	H " K		
Edging and Jointing Agricultural Implements	20 " 30	Q " R		W
Grinding Plow Points	20 " 30	P " Q		U
Surfacing Plow Bodies	20 " 30	N " O	M	P
Stove Mounting	20 " 36	P " Q		
Finishing edges of Stoves	30 " 46	O " P		
Drop Forgings	20 " 30	P " Q		
Gumming and Sharpening Saws	36 " 60	M " N	L	O
Planing Mill and Paper Cutting Knives	30 " 46	J " K	I	M
Car Wheel Grinding	20 " 30	O " P	N	R

VALUE OF EMERY WHEELS.

The increased quantity and quality of work that goes out of the modern machine shop is due to the skillful use of solid emery wheels. A grain of sand from the common grind-stone, magnified, would look like a cobble stone, a fracture of which shows an obtuse angle, whereas a grain of corundum or emery would look like a rhomboid, always breaking with a square or concave fracture. No matter how much it is worn down in use, it does not lose its sharpness, hence it is evident that the grind-stone rubs or grinds and heats the work brought in contact with it, while the corundum, or emery wheel, with its sharp, angular grit, cuts like a file or angular saw.

There are two general classes of emery wheels in the market—one class of wheels has the grains of emery joined and consolidated by a pitchy material, as rubber, linseed oil, shellac, etc. These must run at a high speed to burn out the cementing material by friction, loosening the worn-out grains, and thus revealing new cutting angles. These are non-porous wheels. Truing up this class of wheels is done with a diamond tool.

The other class consists of two kinds, one made by mixing the emery with a mineral cement and water into a paste, which will harden and bind the grains together; the other kind, by mixing the emery with a mineral flux or clay, molding into shape, and burning in a muffle at a high temperature. These are porous wheels, in which the grains of emery are held together by matter having affinity therefor. This class of wheels, unlike the grind-stone, has sharp grains of emery bedded together among matter which, in some cases, is as hard and sharp as the emery itself. Such wheels cut very greedily, and do not need to be run at any particular speed.

The dresser, made of hardened steel picks, is the proper tool for truing up this class of wheels.

Manufacturers in metal goods aiming at reducing the cost of production, would do well to look into the adaptability of the solid emery wheels or rotary file, and other labor-saving machinery, before deciding on reducing labor wages.

HOW BREAKS IN SUBMARINE CABLES ARE DETECTED AND REPAIRED.

The following is an account of how submarine cables are found and repaired at an immense depth:

The break, which the "Minia" was sent to repair, occurred in 1897. The officers of the company first located the distance of the break from the stations on shore, on each side of the ocean. The details of the instrument by which this is done are not easily described, though easily understood in principle.

The machine consists of a series of coils of wire, which offer a known resistance to the electric current. Enough of the coils are connected to make a resistance equal to the resistance offered by the entire cable when it is in working order, and thus, when the machine and cable are connected, a balance is effected. But, if the cable should break, the balance is destroyed, because that portion of the cable between the shore station and the break, wherever it may be, will offer less resistance to the electric current than the entire cable would do. Enough coils of wire are therefore disconnected from the machine to restore the balance. The resistance of the part of the cable that remains intact is thus accurately determined by the number of coils remaining connected with the machine. Having, when the cable was intact, learned the resistance which a mile of cable offers, by dividing the entire resistance by the number of miles of cable, it is easy to find how many miles of cable are still in good order, by dividing the entire resistance of the piece by the known resistance of one mile.

Having determined how many miles from the shore station the break is, orders are sent to go to the place, pick up the ends, and splice them to new piece. Having received such an order and acted on it, Captain Trott found himself and his ship, on July 25, 1897, in latitude 42° 30′ north, and 46° 30′ west, or just to the eastward of the Grand Banks of Newfoundland, with one of the hardest jobs before him that he had had in some time, for sounding showed that the water was about 13,000 feet, or a good deal more than two miles deep. He knew he was somewhere near the break in the cable, but he did not know absolutely within about three or four miles, because, while he had been able to determine his own position by repeated observations of the sun and stars, he could not tell how accurate the observations of the officers of the ship laying the cable had been.

The first work done was to get a series of soundings over a patch of the sea aggregating twenty-five or thirty square miles. The sounding apparatus consisted of an oblong shot of iron, wighing about thirty-two pounds, attached to a pianoforte wire in such a way that, when lowered to the bottom, the shot would jab a small steel tube in the mud down there, and would then release itself from the wire, and allow the sailors to draw up the tube with the mud in it. The moment the weight was released, the men on deck stopped paying out the wire, and thus, knowing how much wire had been run out, they were able to tell the depth. It is a fact that it took twenty-four minutes and ten seconds for the weight of the sounding apparatus to reach bottom in 2,097 fathoms of water.

The ship was now ready to begin the search proper for the cable. She was run off at right angles to the line of the cable for a distance of five miles, and a buoy got down to mark the limits of the territory to be grappled over in that direction. Buoys were afterward set elsewhere to mark the other limits of the territory. The grappling iron was lowered over the bows, the rope attached to it passing over one of the three big grooved wheels that revolve where the bow-sprit of an ordinary vessel stands.

The grappling iron used is the invention of Captain Trott. It looks something like a four-pronged anchor. It has a shaft four feet long, and four arms about a foot long, that are set at right angles to each other at the bottom of the shaft. Right in each crotch formed by the arms is a little button that has a spring behind it that may be regulated in strength. The button projects a third of an inch into the crotch. The angle of the arms with the shaft is so small that a rock could not get down in so far as to reach the button; but, when the cable is caught by the hooks, it presses down against the button, and thus closes an electrical circuit through a copper wire running through the grapnel's rope and the grapnel itself, and a bell is set ringing upon deck. But the experienced men in charge of the grappling are generally able to tell what the hook has hold of without the aid of the bell. They judge by the strain on the rope, which is indicated by a dynamometer on deck. The ordinary strain on the dynamometer is from 3 to 3¼ tons when the grapnel is dragging freely over a smooth bottom as the vessel forges slowly ahead. Sometimes a rock catches on the hooks. This frequently breaks off an arm, but sometimes it fetches clear, the strain indicated by the dynamometer informing the old sailor man in charge whether an accident has happened or not.

It took two hours and twenty minutes to get the grappling iron from the bow of the ship down to the bottom of the sea, 13,000 feet below. The cable used to drag it with is the patent wire and hemp invention of the captain. The dragging began on July 25th, the day of arrival, but they swept backward and forward over the territory for ten days without finding the broken telegraph cable. A good part of the time they were steaming back and forth day and night, and the only time when they were not doing so was when the weather was too bad. On such occasions they went to the buoy at the supposed end of the broken cable, and hove to till the gale was ended.

Finally, on August 5th, the bell rang, indicating that the grapnel had caught the cable. The grapnel drag rope was thereupon fastened to a buoy and thrown overboard. Then the steamer went off two miles toward the end of the broken cable

and got out a cutting grapnel. This is like the other one, except that there are knives in the crotches. When these crotches catch the cable and strain comes on them, they cut the cable off clean.

"Why did you cut off the cable there?" was asked.

"Because, if we had tried to get up the bight of the cable where we first found it, the cable might have broken under the strain. That cable was laid in 1869, and is getting pretty well along in years. It would have been as apt to break on the shore side as the other, but, when we had only an end of two miles to deal with, we were sure of being able to get up without damage. We grappled European end first."

Having cut off the cable, the vessel returned to the buoy on the grappling rope, and, getting the rope inboard again, led it to a drum six feet in diameter located on the upper deck and operated by a steam engine. Then they began to wind in the grapnel rope and hoist the old cable to the bows. They started the drum at 1:20 in the afternoon of August 5, and at 7:51 had the bight of it at the bow of the ship. Then the two miles and odd of end that was hanging down from the bow was fished up and stretched in lengths along the deck until the end was reached. This was connected with a very complete cable telegraph office located amidships, and a second later the operators who had been on watch for days in the British station awaiting this event saw the flashes on a mirror in their office that told them all about it.

Sometimes it happens that, when an end of the cable is picked up in this way, and an attempt is made to communicate with the shore, it is found that there is another break, and that they have only the end of an odd section lying loose. Then they have to drop that over, after testing it to see how long it is, and go on toward the shore and begin over again. In this case, however, they found that they had hold of a sound wire to Great Britain. Without any delay, the end of a new cable was spliced to the old end brought from the bottom. Two experts, one who is trained in splicing cores, and one who is trained in splicing the outside or sheathing, are employed in this work.

When the splice was completed and tested, and found perfect, the cable was started, running out around drums and grooved wheels controlled by brakes, and over the stern, the old end having been led fair through these sheaves before the splicing was done. Then the ship headed for shoal water, and ran away at from three to four knots an hour until over a part of the banks where work could be done more easily than where the water was more than two miles deep. Of course this involved the abandonment of a good many miles of old

cable, but the old cable wasn't of very much importance anyhow.

Arriving in shoal water, the end of the new piece was attached to a buoy and put overboard. Then the old cable was grappled and cut as before, and a new piece was spliced to it. Then the ends of the two new pieces were spliced together and the job was complete. It had taken nearly two months to do it, although in the meantime two easier jobs were attended to, and a trip to Halifax for provisions was made, not to mention the encountering of the storm that damaged the rudder.

The "Minia" has a crew of ninety, all told, including the captain, three deck officers, a navigator, three expert electricians, four engineers, a purser and a surgeon. A blacksmith and a boilermaker, with their tools, are carried. There are three big, round tanks to hold the 600 miles of cable carried, which includes sizes to fit all the old cables under the charge of this ship. There is a cell-room where the electricity for telegraphing is generated, and two dynamos with their engines, one to furnish electricity for a system of arc lights used when at work at night, and the other for the incandescent system that lights the ship below decks. The main saloon is large, and is comfortably and handsomely fitted. The captain has a cabin under the turtle-back aft, as fine as any captain could wish for, and the other officers have rooms below that are as well fitted as those usually occupied by naval officers. The crew are all expert men, and get pay that averages a good deal better than the pay in the packet service between New York and Liverpool. The entire crew is kept under pay the year round, the ship making her headquarters at Halifax when not engaged in repairing cables. They are as comfortable a lot of sailor men as one could find anywhere.

CAMEL'S HAIR BELTING.

Camel's hair belting has been recently the subject of experiments at the Polytechnic School at Munich, from which it appears that the strength of camel's hair belting reaches 6,315 pounds per square inch, whilst that of ordinary belting ranges between 2,230 pounds and 5,260 pounds per square inch. A contemporary says the camel's hair belt is said to work smoothly and well, and is unaffected by acids.

TO PERFORATE GLASS.

In drilling glass, stick a piece of stiff clay or putty on the part where you wish to make the hole. Make a hole in the putty the size you want the hole, reaching to the glass, of

course. Into this hole you pour a little molten lead, when, unless it is very thick glass, the piece will immediately drop out.

HOW TO SELECT ROPE.

A German paper, in an article on the present methods of rope manufacture from hemp, and the determination of the different qualities and the probable strength simply from the appearance, lays down the following rules: A good hemp rope is hard but pliant, yellowish and greenish gray in color, with a certain silvery or pearly luster. A dark or blackish color indicates that the hemp has suffered from fermentation in the process of curing, and brown spots show that the rope was spun while the fibers were damp, and is consequently weak and soft in those places. Again, sometimes a rope is made with inferior hemp on the inside, covered with yarns of good material—a fraud, however, which may be detected by dissecting a portion of the rope, or in practical hands, by its behavior in use; other inferior ropes are made with short fibers, or with strands of unequal strength or unevenly spun—the rope in the first case appearing wooly, on account of the number of ends of fiber projecting, and, in the latter case, the irregularity of manufacture is evident on inspection by any good judge.

BROWNING GUN BARRELS.

Mix 16 parts sweet spirits niter, 12 parts saturated solution of sulphate of iron, 12 parts chloride of antimony. Bottle and cork the mixture for a day, then add 500 parts of water and thoroughly mix. Clean the barrel to a uniform grain free from grease and finger stains. Wipe with a staining mixture on a wad of cotton. Let it stand for twenty-four hours, scratch brush the surface and repeat twice. Rub off the last time with leather moistened with olive oil. Let dry a day, and rub down with a cloth moistened with oil to polish.

HOW TO SHARPEN A PLANE-IRON.

The simple art of sharpening a plane-iron is supposed to be understood by every mechanic, remarks a writer in a contemporary, but there are hundreds of men who cannot do a creditable job in this respect. The common tendency is to round off the edge of the tool until it gets so stunted that under a part of the cutting the tool strikes the work back of the cutting edge. To do the job corrrctly we will begin at the beginning, and grind the tool properly. First, the kind of wood to be cut must be taken into consideration. Common white pine can best be worked with a very thin tool, ground down even to an angle of 30 degrees, provided the make of the tool will allow it. Some planes will not, for the iron stands so "stunt," or nearly per-

pendicular, that its grinding causes a severe scraping action, which soon wears away the tool. In such cases, from 45 to 60 degrees is the proper angle for plane-irons, and this, too, is about right for hard-wood planing.

Determine the angle you want on the plane-iron and then grind to that angle, taking care to grind one flat bevel, and not work up a dozen facets. If the stone be small, say 12 to 18 inches in diameter, the bevel will be slightly concave like the side of a razor, and this is a quality highly prized by many good workmen. In grinding, take care to avoid a "feather edge." If the tool already possesses the right shape, grind carefully right up to this edge, but not grinding it entirely off. The time to stop grinding a tool is just before the old bevel is ground off.

Should the tool need any change of shape, such as the grinding out of a nick or a broken place, then put the edge of the tool against the stone and bring the tool to the desired shape before touching the bevel.

Let the iron lay perfectly flat upon the stone, with a tendency only to bear harder upon the edge of the bevel than upon the heel. Move the iron back and forth on the stone as fast as your skill will allow, taking care that the heel of the bevel is not lifted from the stone. As you become proficient in whetting an iron, the heel may be lifted from the stone about the thickness of a sheet of paper, or just enough to prevent it from touching. The reason why many carpenters cannot set an edge is because they raise their hand too much, and perhaps rock the tool, thus forming a rounding bevel, the sure mark of a poor edge setter.

The proper way to oil-stone a tool is to continue the grinding by rubbing on the oil-stone until the bevel left by the grindstone is entirely moved and the edge keen and sharp. If this be properly done the tool need not be touched upon its face to the stone, but among a dozen good edge-setters not more than one can do it. It is a delicate operation, and can only be acquired by long practice. Nine times out of ten the average workman is obliged to turn the plane-iron over and wet the face thereof, and here is where many men fail who have done the other things well. By raising the back of the tool only a very little the edge is "dubbed off," and regrinding of the face becomes an immediate necessity. A good stone should "set" an edge on a tool which will shave off the hair on a person's wrist without cutting the skin or missing a single hair.

THE USE OF THE STEEL SQUARE.

The standard steel square has a blade 24 inches long and 2 inches wide, and a tongue from 14 to 18 inches long and 1½

inches wide. The blade is exactly at right angles with the tongue, and the angle formed by them an exact right angle, or square corner. A proper square should have the ordinary divisions of inches, half inches, quarters and eighths, and often sixteenths and thirty-seconds. Another portion of the square is divided into twelfths of an inch; this portion is simply a scale of 12 feet to an inch, used for any purpose, as measuring scale drawings, etc. The diagonal scale on the tongue near the blade, often found on squares, is thus termed from its diagonal lines. However, the proper term is centesimal scale, for the reason that by it a unit may be divided into 100 equal parts, and therefore any number to the 100th part of a unit may be expressed. In this scale A B is one inch; then, if it be required to take off 73-100 inches, set one foot of the compasses in the third parallel under 1 at E, extend the other foot to the seventh diagonal in that parallel at G, and the distance between E G is that required, for E F is 1 inch and F G 73 parts of an inch.

Upon one side of the blade of the square, running parallel with the length, will be found nine lines, divided at intervals of one inch into sections or spaces by cross lines. This in the plank, board and scantling measure. On each side of the cross lines referred to are figures, sometimes on one side of the cross line, and often spread over the line, thus, 1 | 4—9 | —. We will suppose we have a board 12 feet long and 6 inches wide. Looking on the outer edge of the blade we find 12; between the fifth and sixth line, under 12, will be found 12 again; this is the length of the board. Now follow the space along toward the tongue till we come to the cross line under 6 (on the edge of the blade), this being the width of the board; in this space will be found the figure 6 again, which is the answer in board measure, viz., six feet.

On some squares will be found on one side of the blade 9 lines, and crossing these lines diagonally to the right are rows of figures, as seven 1s, seven 2s, seven 3s, etc. This is another style of board measure and gives the feet in a board according to its length and width.

In the center of the tongue will generally be found two parallel lines, half an inch apart, with figures between them; this is termed the Brace Rule. Near the extreme end of the tongue will be found 24-24 and to the right of these 33.95. The 24-24 indicate the two sides of a right-angle-triangle, while the length of the brace is indicated by 33.95. This will explain the use of any of the figures in the brace rule. On the opposite side of the tongue from the brace rule will generally be found the octagon scale, situated between two central parallel lines.

This space is divided into intervals and numbered thus: 10, 20, 30, 40, 50, 60. Suppose it becomes necessary to describe an octagon ten inches square; draw a square ten inches each way and bisect the square with a horizontal and perpendicular center line. To find the length of the octagon line, place one point of the compasses on any of the main divisions of the scale and the other length or point on the tenth subdivision.

INVENTOR OF THE SCREW-AUGER.

The screw-auger was invented by Thomas Garrett about 100 years ago. He lived near Oxford, Chester County, Pa. The single screw-auger was invented by a Philadelphian, and it is said to be the only one used with any satisfaction in very hard woods, where the double screw-augers become clogged.

TO FIND THE WEIGHT OF GRINDSTONES.

.06363 times square of inches diameter, times thickness in inches=weight of grindstone in lbs.

A pound of ten-penny cut nails will do as much work as two pounds of wire nails. Taking the average of all cut nails, they are worth nearly double as much as wire nails, from tests made at the Watertown Government Arsenal.

FIRE-PROOFING WOODWORK.

A door of the right construction to resist fire should be made of good pine, and should be of two or more thicknesses of matched boards nailed across each other, either at right angles or at forty-five degrees. If the doorway be more than seven feet by four feet, it would be better to use three thicknesses of same stuff; in other words, the door should be of a thickness proportioned to its area. Such a door should always be made to shut into a rabbet, or flush with the wall when practicable; or, if it is a slide door, then it should be made to shut into or behind a jamb, which would press it up against the wall. Both sides of the door and its jambs, if of wood, should then be sheathed with tin, the plates being locked at joints, and securely nailed under the locking with nails at least one inch long. No air spaces should be left in a door by paneling or otherwise, as the door will resist the best that has the most solid material in it. In most places it is much better to fit the door upon inclined metal sliders than upon hinges.

This kind of door may be fitted with automatic appliances, so that it will close of itself when subjected to the heat of a fire; but these appliances do not interfere with the ordinary methods of opening and shutting the door. They only constitute a safeguard against negligence. The construction of shutters varies from that of doors only in the use of thinner wood.

Under this heading may be classed all the doors of iron, whether sheet, plate, cast or rolled, single, double or hollow, plain or corrugated, none of which are capable of resisting fire for any length of time; also wooden doors covered with tin on one side only, or covered with zinc, which melts at 700 degrees Fahrenheit.

The wooden door covered with tin only serves its purpose when the wood is wholly encased in tin, put on in such a way that no air, or the minimum of air, can reach the wood when it is exposed to the heat of a fire. Under these conditions, the surface of the wood is converted into charcoal; charcoal being a non-conductor of heat, itself tends to retard the further combustion of the wood. But, if air penetrates the tin casing in any measure, the charcoal first made, and then the wood itself, are both consumed, and the door is destroyed. In like manner, if a door is tinned only on one side, as soon as the heat suffices to convert the surface of the wood under the tin and next to the fire into charcoal, the oxygen reaches it from the outside, and the door is of little more value than a thin door of iron, or plain wooden door.

HOW TO PREPARE CALCIMINE.

Soak one pound of white glue over night; then dissolve it in boiling water, and add twenty pounds of Paris white, diluting with water until the mixture is of the consistency of rich milk. To this any tint can be given that is desired.

Lilac—Add to the calcimine two parts of Prussian blue and one of vermilion, stirring thoroughly, and taking care to avoid too high a color.

Gray—Raw umber, with a trifling amount of lamp-black.

Rose—Three parts of vermilion and one of red lead, added in very small quantities until a delicate shade is produced.

Lavender—Mix a light blue, and tint it slightly with vermilion.

Straw—Chrome yellow, with a touch of Spanish brown.

Buff—Two parts spruce, or Indian yellow, and one part burnt sienna.

REDWOOD FINISH.

The following formula and directions have been highly recommended:

Take one quart spirits turpentine.
Add one pound corn starch.
Add ¼ " burnt sienna.
Add one tablespoonful raw linseed oil.
Add " " brown Japan.

Mix thoroughly, apply with a brush, let it stand say fifteen minutes; rub off all you can with fine shavings or a soft rag,

then let it stand *at least twenty-four hours*, that it may sink into and *harden* the fibers of the wood; afterwards apply two coats of white shellac, rub down well with fine flint paper, then put on from two to five coats best polishing varnish; after it is well dried, rub with water and pumice-stone ground very fine, stand a day to dry; after being washed clean with chamois, rub with water and rotten-stone; dry, wash as before clean, and rub with olive oil until dry.

Some use cork for sand-papering and polishing, but a smooth block of hard wood, like maple, is better. When treated in this way, redwood will be found the peer of any wood for real beauty and life as a house trim or finish.

A POLISH FOR WOOD.

The wooden parts of tools, such as the stocks of planes and handles of chisels, are often made to have a nice appearance by French polishing; but this adds nothing to their durability. A much better plan is to let them soak in linseed oil for a week, and rub with a new cloth for a few minutes every day for a week or two. This produces a beautiful surface, and has a solidifying effect on the wood.

BURYING A SCREW HEAD OUT OF SIGHT.

To get the heads of nails and screws out of sight, where glue can be used without any objection, just raise up a chip with a thin paring chisel, and then set the nail in solid. This "leaf" can be covered with a coating of glue and laid back again in place, where it must fit on all sides to perfection. A dead weight will hold everything in place till the glue dries, and a few moments with the scraper makes the job complete. It will add to the nicety of the work to draw lengthwise with the grain two deep cuts with a thin case-knife just the width of the chisel, and this keeps the sides of the chips from splitting. The chisel should be set at a steep angle at first till the proper depth is reached, and then made to turn out a cut of even thickness until there is room to drive a nail. If too sharp a curve is given, the leaf is likely to break apart in being straightened out again. In blind nailing a narrow chip is taken with a tool made especially for this purpose, that lifts the cut just high enough to let in the nail on the slant, a set slightly concaved, being used to keep it from ever slipping off the head, and the upraised cut driven down again with the hammer.

USES OF MICA.

The peculiar physical characteristics of mica, its resistance to heat, transparency, capacity of flexure and high electric resistance, adapt it to applications for which there does not

appear to be any perfect substitute. Its use in windows, in the peep-holes on the furnaces used in metallurgical processes, as well as the ordinary use in stoves for domestic purposes, are examples of its adaptability to specific purposes which it does not seem to share with any other material. Its fitness for use in physical apparatus is represented by its application for the vanes on the Coulomb meter, recently invented by Prof. George Forbes, F. R. S. For electrical purposes mica has proved useful, acting as an insulator between the segments of commutators of dynamos and safety fuses in lighting circuits, also as the base part of switches handling heavy currents, to obviate the dangers of ignition by the arc formed when the switch is changed. For this latter purpose it shares the field with sheets of slate. Both of these uses were first suggested a number of years ago by an insurance expert in the course of regulations governing the safe installation of electric light plants. As a lubricator, mica answers a very peculiar purpose for classes of heavy bearing, where the powdered mica serves a useful office in keeping the surface separate, thereby permitting the free ingress of oil. It is used in roof-covering mixtures in a powdered condition in combination with coal tar, ground steatite and other materials, its foliated structure tending to bond the material together. Not affected by ordinary chemicals which are corrosive to many other substances, it has been applied in the valves to sensitive automatic sprinklers, where a sheet of mica placed over a leather disk has proved to be non-corrosive, and without possibility of adhering to the seat, while the leather packing rendered the whole sufficiently elastic to provide a tight joint. Mica is also used in making lamp chimneys.

HOW TO DETECT GAS LEAKAGE.

In order to detect gas leakage, Dr. Bunte, in the *Canadian Magazine of Science*, suggests the use of paper dipped in palladium chloride solution. Such paper changes its color in presence of gas coming from the leaks imperceptible by the odor, and which produce no effect upon the earth covering the pipes. Dr. Bunte suggests the following method of practically applying the test to street mains: Above the pipes are excavated, at intervals of two or three yards, holes twelve to sixteen inches deep, corresponding to the joints and sleeves. In each opening is placed an iron tube, half an inch in diameter, within which is a glass tube, containing a roll of the test paper. The air from about the main enters the iron tube, and the trace of gas which may be present reveals itself by coloring the paper brown or black, according to the quantity. If, after ten or twenty minutes, the paper is still white, it may be certainly

concluded that at the point tested there is not the smallest escape of gas. Various authorities who have experimented with Bunte's method certify to its efficacy.

THE BANK OF ENGLAND DOORS.

The Bank of England doors are now so finely balanced that a clerk, by pressing a knob under his desk, can close the outer doors instantly, and they cannot be opened again except by special process. This is done to prevent the daring and ingenious unemployed of the metropolis from robbing the bank. The bullion departments of this and other banks are nightly submerged several feet in water by the action of the machinery. In some banks the bullion department is connected with the manager's sleeping room, and an entrance cannot be effected without shooting a bolt in the dormitory, which in turn sets in motion an alarm. If a visitor, during the day, should happen to knock off one from a pile of half sovereigns the whole pile would disappear, a pool of water taking its place.

HOW TO FIGURE BICYCLE GEARS.

To ascertain the gear of a CHAIN-DRIVEN BICYCLE, multiply the diameter of the rear wheel by the number of the teeth on the front sprocket, and divide the product by the number of teeth on the rear sprocket.

To ascertain the gear of a WHEEL DRIVEN BY BEVEL GEARING, divide the number of teeth on the driving gear on the crank axle by the number of teeth on the gear on the forward end of the gear shaft. Multiply the quotient thus obtained by the number of teeth on the gear at the rear end of the gear shaft, and divide the product by the number of teeth on the gear on the rear hub. Multiply the result by the diameter of the rear wheel.

RULES OF THE ROAD FOR CYCLISTS.

To ride a bicycle well means, in addition to ability to manage the wheel, a knowledge of both the written and unwritten laws of the road and a respect for the rights of others using the public highways. A city street crowded with vehicles and pedestrians, or a narrow country road full of trouble to the beginner, become very clear to the rider who observes the following three fundamental rules;

1. Always keep to the *right* of the center of the road.

2. Always pass to the *right* of a vehicle, rider or pedestrian approaching you.

3. Always pass to the *left* of a vehicle, rider or pedestrian going in the same direction as yourself.

In addition to the above fundamental laws of the highway, the following suggestions may be of service: Pass behind a pedestrian crossing the street. Two or more riders in company should all follow the same rule in passing either vehicles, other riders or pedestrians. Do not "scorch" on crowded streets. Always have your wheel under full control at road intersections. Keep a good lookout ahead and watch all crossings carefully.

HOW TO APPLY A TRANSFER.

The proper handling of a transfer is a very plain and simple process, yet somehow the slightest deviation from the proper method will spoil the ornament. The chief requisites to the successful handling of a transfer ornament are: 1st. A good transfer. 2nd. A proper sizing for transferring and a proper varnish for covering. 3rd. The proper degree of baking, if the article upon which the transfer is placed is to be baked. The simplest method of handling a transfer in its application as an ornament or name plate is as follows; Coat either the transfer or the article with a thin coat of quick drying tacky sizing. This sizing should be the very finest varnish, and should be very thin and flow readily. Mix with the varnish as much turpentine as is necessary to secure this result. Be sure to get as thin as possible a coat of sizing on the transfer or the article, as the thinner you get it the better and smoother it ought to lay. You need not be afraid of getting over the edge of the transfer with the varnish; be sure, however, not to to get any spots of varnish on the back of the transfer. Place the transfer on the article and rub it so that the varnish will stick properly wherever there is any transfer. It is usually customary to take a slightly damp—not wet—sponge when rubbing, as you make the paper pliable in that way, and take out stiffness, and thereby make the transfer more liable to hold on all spots and places. Of course before you apply the transfer the varnish must be tacky; you can tell that by trying it with your finger. If the transfer sticks readily to the finger when you lift it up it is in a fit condition to apply. After having rubbed the transfer thoroughly, take a soaked sponge (with warm water) and rub again lightly; be very careful in rubbing this time, that the transfer does not slip. The object of this is to keep the transfer from tearing, for you can readily see part of the transfer may have released from the paper, whereas the other part may still be sticking, and any slip of the paper will naturally tear the transfer. Should any varnish accidentally have gotten on the back of the paper, covering the transfer, peel it off by placing a little water on the paper and rubbing. This will peel off that spot of varnish very easily,

and then soak that spot with water. Lift or peel off the paper, after the water is thoroughly soaked through, take a soft sponge soaked in water and clean off the fuzz and chemical from the transfer and around it. This will still leave the varnish all around the edges of the transfer. To cut that away, take a little gasoline, turpentine or benzine, mixed with water, dampen a piece of cotton or soft sponge with either of these mixtures, and again clean over the transfer; immediately after, go over with water, so as to prevent the cutting fluid eating away any of the transfer. After this you have a clean and neat appearing transfer free from all varnish, fuzz and dirt. *Always use warm water.* After the transfer is applied and thoroughly cleaned as above described, give it a coat of varnish to protect the surface of the transfer from rubbing or scratching. If the transfer is on an enameled surface it is necessary to bake at this time. An important point to consider is that all transfers when just completed or when fresh are delicate, and the colors at times may not be thoroughly dry, in which event they will be affected by the cleaning substance.

Manufacturers: Use a paperhanger's rubbing seaming roller, if you have much transferring to do.

POINTS OF INTEREST.

Telephone invented, 1861.

Iron horseshoes were made in 481.

First telegraph in operation in America was between Washington and Baltimore, May 27, 1844.

The first iron ore discovered in this country was found in Virginia in 1715.

The first steam engine on this continent was brought from England in 1753.

The largest suspension bridge is the Brooklyn. The length of the main span is 1,595 feet 6 inches. The entire length of the bridge is 5,989 feet.

The longest span of wire in the world is used for a telegraph in India over the river Ristuah. It is over 6,000 feet, and is stretched between two hills, 1,200 feet high.

A "monkey wrench" is not so named because it is a handy thing to monkey with, or for any kindred reason. "Monkey" is not its name at all, but "Moncky." Charles Moncky, the inventor of it, sold his patent for $2,000, and invested the money in a house in Williamsburgh, Kings County, N. Y., where he now lives.

"Liberty," Bartholdi's statue, presented to the United States by the French people in 1885, is the largest statue ever built. Its conception is due to the great French sculptor whose name it bears. It is said to be a likeness of his mother. Eight years

of time were consumed in the construction of this gigantic brazen image. Its weight is 440,000 pounds, of which 146,000 pounds are copper, the remainder iron and steel. The major part of the iron and steel was used in constructing the skeleton framework for the inside. The mammoth electric light held in the hand of the giantess is 305 feet above tide-water. The height of the figure is 152½ feet; the pedestal 91 feet, and the foundation 52 feet and 10 inches. Forty persons can find standing room within the mighty head, which is 14½ feet in diameter. A six-foot man standing on the lower lip could hardly reach the eyes. The index finger is eight feet in length and the nose 3¾ feet. The Colossus of Rhodes was a pigmy compared with this latter day wonder.

The great pyramid of Cheops is the largest structure of any kind ever erected by the hand of man. Its original dimensions at the base were 764 feet square, and its perpendicular height in the highest point 488 feet; it covers four acres, one rood, and twenty-two perches of ground and has been estimated by an eminent English architect to have cost not less than £30,000,000, which in United States currency would be about $145,200,000. Internal evidence proves that the great pyramid was begun about the year 2170 B. C., about the time of the birth of Abraham. It is estimated that about 5,000,000 tons of hewn stone were used in its construction, and the evidence points to the fact that these stones were brought a distance of about 700 miles from quarries in Arabia.

The largest and grandest temple of worship in the world is the St. Peter's Cathedral at Rome. It stands on the site of Nero's circus, in the northwest part of the city, and is built in form of a Latin cross. The total length of the interior is 612½ English feet; transept, 446½ feet; height of nave, 152½ feet; diameter of cupalo, 193 feet; height of dome from pavement to top of cross, 448 feet. The great bell alone without the hammer or clapper weighs 18,600 pounds, or over 9¼ tons. The foundation was laid in 1450 A. D. Forty-three Popes lived and died during the time the work was in progress. It was dedicated in the year 1826, but not entirely finished until the year 1880. The cost, in round numbers, is set down at $70,000,000.

The Capitol building at Washington, D. C., is the largest building in the United States. The corner stone was laid December 18, 1793, by President Washington, assisted by other Masons. It was partially destroyed by the British in 1814. The present dome was begun in 1855 and finished in 1863. The flag of the United States first floated from it December 12, 1863. The cost of the entire building has been something over $13,000,000. Its length is 715 feet 4 inches; width, 324 feet. It covers 3½ acres of ground. The distance from the ground to

the top of the dome is 307½ feet; diameter of the dome, 135½ feet—making fifth as to size with the greatest domes of the world.

The largest and costliest private mansion in the world is that belonging to Lord Bute, called Montstuart, and situated near Rothesay, Scotland. It covers nearly two acres; is built in gothic style; the walls, turrets and balconies are built of stone. The immense tower in the center of the building is 120 feet high, with a balcony around the top. The halls are constructed entirely of marble and alabaster, and the rooms are finished in mahogany, rosewood and walnut. The fire-places are all carved marbles of antique design. The exact cost of this fairy palace is not known, but it has never been estimated at less than $8,000,000.

The corner stone of the Washington monument, the highest in the United States, and until 1889 the highest in the world, was laid July 4, 1848. Robert E. Winthrop, then the Speaker of the House, delivered the oration. Work progressed steadily for about six years, until the funds of the monumental society became exhausted. At that time the monument was about 175 feet high. From 1854 until 1879 nothing to speak of was done on the building. In the year last above named Congress voted an appropriation of $200,000 to complete the work. From that time forward work progressed at a rapid rate until December 6, 1884, when the aluminum apex was set at 555 feet 5½ inches from the foundation and the work declared finished. The foundation is 146½ feet square; number of stones used above the 130-foot level, 9,163; total weight stone used in work, 81,120 tons.

The famous Corliss engine, the largest ever constructed, and the one used to drive the machinery in the great hall at the Centennial of 1876, is now in the shops of the Pullman Car Company at Pullman, near Chicago, Ill. The writer is aware that this differs from other statements that have been made, it being generally supposed that the Emperor of Brazil bought the engine and removed it to his own country. He did talk of buying it, but the bargain was never consummated. This tireless giant works in an upright position, is over 40 feet high, of 1,400 horse-power, and has two 40-inch cylinders and a 10-foot stroke.

The highest building in the world, not counting the Eiffel tower and the Washington monument, is the Cologne cathedral. The height from the pavement to the top of the cupola is 511 feet. It is 511 feet long, exactly the same as the height, and 231 feet wide. It was begun August 15th in the year 1248, and was pronounced finished August 14, 1880, over 600 years after the corner stone was laid.

The largest anvil is that used in the Woolwich Arsenal, England. It weighs sixty tons. The anvil block upon which it rests weighs 103 tons. Altogether 600 tons of iron were used in the anvil, the block and the foundation work. It is said to have been six months cooling before it was sufficiently hard to stand the shock of the immense hammer.

INTERESTING FACTS OF SCIENCE AND STATISTICS.

The largest bells are the following, and their weight is given in tons: Moscow, 216; Burmah, 117; Pekin, 53; Novgorod, 31; Notre Dame, 18; Rouen, 18; Olmutz, 18; Vienna, 18; St. Paul's, 16; Westminster, 14; Montreal, 12; Cologne, 11; Oxford, 8; St. Peter's, 8.

Bell metal should have 77 parts copper, and 23 tin.

One horse-power will raise 16½ tons per minute a height of 12 inches, working eight hours a day. This is about 9,900 foot-tons daily, or 12 times a man's work.

The horse-power of Niagara is 3¼ million nominal, equal to 10 million horses effective.

CANDLE-POWER.—The candle-power of a light may be approximately calculated by comparing the shadow cast by a rod in the light of a standard candle, with the shadow cast by the light to be tested. By moving the latter toward or away from the rod, a point will be reached at which the shadow cast by both lights will be of the same intensity. The intensities of the two lights are directly proportional to the squares of their distances from the shadows; for example, suppose the light to be tested is three times the distance of the candle, its illuminating power is nine times as great.

USEFUL RECIPES, ETC.

To Take Smoke Stains from Walls—An easy and sure way to remove smoke stains from common plain ceilings is to mix wood ashes with the whitewash just before applying. A pint of ashes to a small pail of whitewash is sufficient, but a little more or less will do no harm.

To Remove Oil Stains from Wood—Mix together Fuller's earth and soap lees, and rub it into the boards. Let it dry and then scour it off with some strong soft soap and sand, or use lees to scour it with. It should be put on hot, which may easily be done by heating the lees.

To Disinfect Sinks and Drains—Copperas dissolved in water, one-fourth of a pound to a gallon, and poured into a sink and water drain occasionally, will keep such places sweet and wholesome. A little chloride of lime, say half a pound to a

gallon of water, will have the same effect, and either of these costs but a trifle.

A preparation may be made at home which will answer about as well as the chloride of lime. Dissolve a bushel of salt in a barrel of water, and with the salt water slack a barrel of lime, which should be made wet enough to form a thin paste or wash.

To Disinfect a Cellar—A damp, musty cellar may be sweetened by sprinkling upon the floor pulverized copperas, chloride of lime, or even common lime. The most effective means ever used to disinfect decaying vegetable matter is chloride of lime in solution. One pound may be dissolved in two gallons of water. Plaster of Paris has also been found an excellent absorbent of noxious odors. If used one part with three parts of charcoal, it will be found still better.

How to Thaw Out a Water Pipe—Water pipes usually freeze up when exposed, for inside the walls, where they cannot be reached, they are or should be packed to prevent freezing. To thaw out a frozen pipe, bundle a newspaper into a torch, light it, and pass it along the pipe slowly. The ice will yield to this much quicker than to hot water or wrappings of hot cloths, as is the common practice.

How to Test a Thermometer—The common thermometer in a japanned iron case is usually inaccurate. To test the thermometer, bring water into the condition of active boiling, warm the thermometer gradually in the steam and then plunge it into the water. If it indicate a fixed temperature of two hundred and twelve degrees, the instrument is a good one.

To Remove Paint from Window Glass—Rub it well with hot, sharp vinegar.

To Clean Stovepipe—A piece of zinc put on the live coals in the stove will clean out the stovepipe.

To Clean Brassware—Mix one ounce of oxalic acid, six ounces of rotten stone, all in powder, one ounce of sweet oil, and sufficient water to make a paste. Apply a small proportion, and rub dry with a flannel or leather. The liquid dip most generally used consists of nitric and sulphuric acids, but this is more corrosive.

Game Laws.

(*Revised to 1900.*)

By kind permission of the Peters Cartridge Co.

It has been found more convenient for those contemplating a hunt to know *when game may be killed*, rather than when protected. The dates given indicate the time during which it is permitted to kill game. For example, "October 1 to January

1," signifies that during the months of October, November and December the game mentioned may be killed.

It is not necessary to mention the fines and punishments. In general, it may be said that infractions of game laws are punishable by heavy fines and sometimes by imprisonment also.

Arizona—Quail, partridge, grouse, turkey, October 15 to March 1. Duck, goose, brant, October 1 to April 1. Dove, June 1 to March 1. Deer, antelope, August 1 to December 15. Bucks, other than deer or antelope, for camp or domestic use, October 1 to February 1. Protected: Female deer and antelope, elk, mountain sheep or goat, spotted fawn; pheasants, prairie chicken, bob-white until 1902. Prohibited: Exporting.

Arkansas—Quail, October 1 to March 1. Turkey, September 1 to May 1. Deer, August 1 to February 1. Protected: Prairie chicken until April 12, 1901. Prohibited: Exporting until April 12, 1901. Non-residents taxed $25.00. Local laws.

Colorado—Turkey, prairie chicken, sage chicken, grouse, August 15 to October 31. Duck, goose, snipe, curlew, brant, swan, crane, September 1 to April 15; in altitudes exceeding 7,000 feet, September 15 to April 15. Pigeon, dove, July 15 to September 30. Deer and antelope having horns, October 25 to November 5. Protected: Quail, pheasant, partridge, ptarmigan, bison, buffalo, mountain sheep. Prohibited: Killing, by one person, more than 50 ducks and 25 other birds in one day, or more than one elk, antelope and deer, or two antelope, or two deer, in one season; trespassing or shooting from public highway.

Idaho—Quail, October 31 to December 1. Partridge, pheasant, grouse, prairie chicken, sage and fool hen, August 15 to December 1. Duck, goose, swan, August 15 to March 1. Deer, antelope, mountain sheep or goat, September 1 to January 1. Elk, September 1 to December 1. Protected: Moose, caribou, beaver, until 1904; Mongolian pheasant, until 1902; buffalo, bison, indefinitely. Prohibited: Killing in one season more than 4 each of deer, antelope, mountain sheep or goat, or two elks.

Illinois—Quail, November 1 to December 20. Pinnated and ruffed grouse, prairie chicken, pheasant, partridge, September 1 to October 1. Woodcock, dove, September 1 to December 1. Snipe, plover, September 1 to April 25. Duck, goose, brant, all water fowl, September 1 to April 15. Turkey, September 1 to January 15. Squirrel, September 1 to December 15. Protected: Deer, imported pheasants, cacubis, chucker partridge, sand grouse, black India partridge, until 1904. Prohibited: Sale of game killed in State; exporting. Non-residents taxed $10.00.

Indian Territory—All game protected except for immediate subsistence while passing through the country.

Iowa—Quail, ruffed grouse, pheasant, turkey, November 1 to January 1. Prairie chicken, September 1 to December 1. Woodcock, July 10 to January 1. Duck, goose, brant, September 1 to April 15. Squirrel, June 1 to January 1. Protected: Ruffed grouse, turkey, until January 1, 1900; deer, elk, goat, indefinitely. Prohibited: Killing quail on public highway; hunting for market; killing more than 25 birds or fowl in one day; trespassing; exporting.

Kansas—Quail, grouse, prairie chicken, October 1 to November 30. Protected: Pheasant, meadow lark, dove. Prohibited: Sale of game and exporting.

Missouri—Quail, prairie chicken, partridge, pheasant, turkey, November 1 to January 1. Woodcock, dove, lark, plover, August 1 to January 1. Duck, October 1 to April 1. Deer, one year old and over, October 1 to January 1. Coon, mink, otter, beaver, musk rat, November 1 to April 1. Protected: Does, California valley and mountain quail, Texas quail, Chinese pheasant. Prohibited: Exporting from counties where killed; hunting by non-residents.

Nebraska—Quail, turkey, November 1 to January 1. All kinds of grouse, pheasant, prairie chicken, September 1 to January 1. Snipe, woodcock, plover, duck, goose, September 1 to May 1. Deer, elk, antelope, November 1 to January 1. Mink, otter, musk rat, February 15 to April 15. Protected: Mongolian and all imported pheasants, until 1905. Prohibited: Exporting.

Nevada—Quail, partridge, pheasant, woodcock, grouse, bittern, yellow hammer, September 15 to March 15. Duck, goose, crane, brant, swan, plover, curlew, snipe, mud hen, September 15 to April 1. Sage cock, hen or chicken, August 15 to March 1. Deer, elk, antelope, mountain sheep or goat, caribou, September 1 to January 1.

New Mexico—Quail, grouse, prairie chicken, pheasant, partridge, turkey, September 1 to March 1. Deer and antelope with horns, September 1 to December 1. Protected: Elk, fawn, ibex, mountain sheep or goat, beaver, Mongolian pheasant, until March 10, 1902. Prohibited: Exporting.

Oklahoma—Quail, October 15 to February 1. Prairie chicken, turkey, September 1 to January 1. Plover, dove, August 31 to December 31. Protected: Mongolian and other pheasants until January 1, 1904; deer, antelope, indefinitely.

Texas—Quail, partridge, October 1 to March 15. Prairie chicken, August 1 to February 1. Turkey, September 1 to

April 1. Deer, September 1 to January 1. Protected: Antelope, English and Mongolian pheasants, until 1902. Prohibited: Exporting; sale of deer or antelope killed in State.

Utah—Quail, October 1 to March 1, in Kane and Washington counties only. Partridge, pheasant, prairie chicken, sage hen, grouse, August 15 to December 1. Dove, July 1 to December 1. Duck, goose, snipe, brant, swan, September 15 to April 1. Protected: Quail, except in counties specified; Mongolian, Chinese and English pheasants, pinnated grouse; elk, antelope, mountain sheep, buffalo, bison, beaver, otter. Prohibited: Exporting; killing more than 2 deer in one season.

TRAP RULES

OF THE

AMERICAN SHOOTING ASSOCIATION.

Revised November 1, 1898, by C. W. Dimick.

Rules for Inanimate Target Shooting.

RULE 1—JUDGES AND REFEREE.

Two judges and a referee, or a referee alone, shall be selected by the management, or the contestants, whose decision shall be final.

RULE 2.—DUTIES OF THE REFEREE.

The referee shall see that the traps are properly set at the beginning of the match, and kept in order to the finish. He shall endeavor to make the targets conform to the flight and direction indicated in Rule No. 7. He shall test any trap upon application of the shooter at any time by throwing a trial target therefrom. He may at any time, and must when so requested by a contestant, select one or more cartridges from those of a shooter at the score, and publicly test the same for proper loading. If the cartridge, or cartridges, are found to be improperly loaded, the shooter shall suffer the penalty as provided for in Rule No. 11.

RULE 3.—SCORER.

A scorer shall be appointed by the management, whose score shall be the official one. All scoring shall be done with ink, or indelible pencil. The scoring of a lost target shall be indicated by a "0," and a broken target by the figure "1."

RULE 4.—PULLER.

A puller or pullers, shall be appointed by the management, whose duty it shall be to see that the trap or traps shall be instantly sprung when the shooter calls "Pull," and shall be placed in such a position that the shooter will have no means of knowing by his actions which trap is to be pulled. In single target shooting he shall pull the trap as decided by a trap-pulling indicator, or other means that may have been provided by the management, so that the shooter will have no means of knowing from which trap the target is to be thrown.

RULE 5.—PULLING THE TRAPS,

SECTION 1. Traps may be pulled in regular order from 1 to 3, or 1 to 5, or *vice versa*, if so decided by the management.

SEC. 2. If the shooting is from traps to be pulled in regular order, the shooter may refuse the target from the trap not so pulled; but if he shoots, the result must be scored.

SEC. 3. If the trap is sprung before, or at any noticeable interval after the shooter calls "Pull," he can accept or refuse the target; but if he shoots, the result must be scored.

SEC. 4. If the puller, or pullers, do not pull in accordance to the indicator, or other means provided, they shall be removed and others substituted.

RULE 6.—ARRANGEMENT OF TRAPS.

All matches shall be shot from three or five traps, set level, 3 or 5 yards apart, in the segment of a circle, or in a straight line. When in the segment of a circle, the radius of the circle shall be eighteen yards. In all cases the shooter's position shall not be less from each trap than the rises provided for in Rule 7. The traps shall be numbered from 1 on the left, to No. 3 or No. 5, on the right, consecutively, according to the number used.

RULE 7.—ADJUSTING TRAPS.

SECTION 1. All traps must be adjusted to throw the targets a distance of not less than 40 yards, nor more than 65 yards.

SEC 2. The elevation of the target in its flight at a distance of 10 yards from the trap shall not be more than 12 feet, nor less than 6 feet, and the angles of flight shall be as follows:

If three traps are used—
No. 1 trap shall be set to throw a left quartering target.
No. 2 trap shall be set to throw a straightaway target.
No. 3 trap shall be set to throw a right quartering target.

If five traps are used—
No. 1 trap shall be set to throw a right quartering target.

No. 2 trap shall be set to throw a left quartering target.
No. 3 trap shall be set to throw a straightaway target.
No. 4 trap shall be set to throw a right quartering target.
No. 5 trap shall be set to throw a left quartering target.

Traps Nos. 1 and 5 shall be set to throw the targets so that the line of flight shall cross that of the straightaway target at a point not less than 10 yards nor more than 20 yards from trap No. 3.

SEC. 3. After the traps are set for these angles, if the target for any reason shall take a different course it shall be considered a fair target, provided that the referee decides it offered a fair shot to the contestant.

RULE 8.—SCREENS.

Either pits or screens, or both, may be used, but the screens must not be higher than is actually necessary to fully protect the trapper.

RULE 9.—THE RISE.

In single target shooting the rise shall be:
18 yards for 10-gauge guns.
16 yards for 12-gauge guns.
14 yards for 14 and 16-gauge guns.
13 yards for 20-gauge guns.

In double target shooting the rise shall be:
16 yards for 10-gauge guns.
14 yards for 12-gauge guns.
12 yards for 14 and 16-gauge guns.
11 yards for 20-gauge guns.

RULE 10.—CALIBER AND WEIGHT OF GUNS.

No gun of larger caliber than 10-gauge shall be used, and the weight of all guns shall be limited as follows:
10-gauge, 9 pounds 4 ounces.
12-gauge, 8 pounds 4 ounces.
14 and 16-gauge, 7 pounds 12 ounces.
20-gauge, 7 pounds 8 ounces.

RULE 11.—LOADS.

Charge of powder unlimited. Charge of shot not to exceed one and one-quarter ounces American Association, or Dixon's measure, struck. Any shooter using a larger quantity of shot shall forfeit his entrance money and rights in the match.

NOTE.—If, in the opinion of the management, with the unanimous consent of the contestants, a shooter has not wilfully violated this rule, his entrance money shall be returned to him.

RULE 12.—LOADING GUNS.

In single target shooting, only one barrel shall be loaded at a time, and the cartridge shall not be placed in the barrel until after the shooter has taken his position at the score.

In double target shooting, both barrels shall be loaded at the score. Cartridges must be removed from the gun before leaving the score.

RULE 13.—POSITION OF GUN.

Any the shooter may adopt.

RULE 14.—SINGLE TARGET SHOOTING.

When the traps are set in the segment of a circle, each contestant shall shoot at three or more targets before leaving the score. If two targets are sprung at the same time and the contestant does not shoot, it shall be declared "No Target;" but if he shoots the result must be scored.

RULE 15.—DOUBLE TARGET SHOOTING.

Both traps must be pulled simultaneously, and each contestant shall shoot at three or five pairs, consecutively, thrown as follows: If three traps are used, the first pair shall be thrown from 1 and 2, the second pair from 2 and 3, the third pair from 1 and 3, the fourth pair from 1 and 2, and the fifth pair from 2 and 3.

If five traps are used, the first pair shall be thrown from 2 and 3, the second pair from 3 and 4, the third pair from 2 and 4, the fourth pair from 2 and 3, and the fifth pair from 3 and 4.

If only one target is thrown, it shall be declared "No targets."

If a target be lost for reasons stated in Rule 19, Sec. 1, it shall be declared "No targets." If one be fair and the other an imperfect target, it shall be declared "No targets." But if the shooter accepts an imperfect target, or targets, the result must be scored.

If both targets are broken by one barrel, it shall be declared "No targets." If the shooter fires both barrels at one target intentionally, it shall be scored "Lost targets." But if the second barrel be discharged accidentally, it shall be "No targets."

RULE 16.—UNKNOWN ANGLES.

In unknown angles each trap must be changed so as to throw the target in a different direction from the one last thrown by it. The extreme angles at which the targets are thrown, shall not be greater than those provided for by Rule 7.

If an unfair target is thrown, it shall be declared "No target;" but if accepted by contestant the result must be scored.

RULE 17.—RAPID FIRING SYSTEM.

When the traps are set in a straight line and the rapid firing system is to be used, there shall be a screen before each

trap on which shall appear the number of the trap, from No. 1 on the left, and each shooter shall stand at score opposite the trap from which the target is to be thrown for him to shoot at.

After he has shot at his first target he shall pass to the next score to the right, and so continue until he reaches the end of the score, when he shall return to the score opposite No. 1, and continue as before until his score is finished. If shooters are annoyed, or there is delay in shooting by the smoke of previous shots, the traps may be pulled in reverse order, commencing with the trap on the right.

RULE 18.—CLASS SHOOTING.

All contestants who are tied on highest score shall divide first money, and those tied on next highest score divide second money, etc. Should a majority in any tie decide to shoot it out, high gun to take purse, any individual in said tie shall have a right to withdraw his *pro rata* of money.

All shooting shall be class shooting unless otherwise stated by the management.

RULE 19.—BROKEN TARGETS.

A target to be scored "broken," must have a perceptible piece broken from it while in the air. A "dusted" target is not a broken target. No target shall be retrieved for shot marks.

If a target be broken by a trap, the shooter may claim another target, but if he shoots, the result must be scored.

RULE 20.—ALLOWING ANOTHER TARGET.

SECTION 1. The shooter shall be allowed another target for the following reasons:

A—For a target broken by the trap.

B—For any defect in the gun, or load, causing a mis-fire.

C—If the contestant is interfered with, or balked, or there is other similar reason why it should be done, the referee may allow another target.

SEC. 2. If the shooter is balked at known traps, he shall have another target from same trap. But if the balk occurs at unknown traps, the indicator shall again be turned and a new combination used barring traps which have been fairly sprung.

NOTE.—When a shooter in breaking his gun to put in the shell fails to break it far enough to cock the gun, it is considered his own carelessness, and not sufficient excuse for the allowance of another target.

RULE 21.—LOST TARGETS.

Targets shall be scored lost if the shooter fails to load, cock, adjust safety on gun, or pulls the wrong trigger.

RULE 22.—TIE SHOOTING.

SECTION 1. All ties shall be shot off at the original distance, and as soon after the match as practicable, at the following number of birds:

Ties on Single Targets.—In single target matches of 25 targets, or less, on three traps, 3 targets; five traps, 5 targets. In matches of 26 targets to 50 inclusive, on three traps, 6 targets; five traps, 10 targets. In matches of over 50 on three traps, 15 targets; five traps, 25 targets.

Ties on Double Targets.—In double target matches of 10 pairs or less, on three traps, 3 pairs. In matches of more than 10 pairs, 5 pairs thrown from traps 1 and 3. If five traps are used, the same number shall be thrown in each case from traps 2 and 4 (unless otherwise arranged by the management, and so stated or understood previous to the beginning of the match).

SEC. 2. If in a series of matches the result prove a tie, such tie shall be shot off at the original number of targets.

RULE 23.—ANNOUNCING THE SCORE.

SECTION 1. When two judges and a referee are serving, one of the judges shall announce the result of each shot distinctly, and it shall be called back by the scorer.

(The call for a broken target shall be "Broke," and the call for a missed target shall be "Lost.")

If the second judge disagrees with the decision of the judge calling, he shall announce it at once before another target is thrown, and the referee shall decide it. In case of another target being thrown before the referee's decision, the target so thrown shall be "No Target."

SEC. 2. At the close of each shooter's score the result must be announced. If claimed to be wrong, the error, if any, must be corrected at once.

RULE 24.—SHOOTER AT THE SCORE.

In all contests the shooter must be at the score within three minutes after his name is called to shoot, or he forfeits his rights in the match.

RULE 25.—FORBIDDEN SHOOTING.

No shooting will be permitted in the enclosure other than at the score; and in case there is no enclosure, no shooting within 200 yards of the score, without the consent of the management.

Rules for Live Bird Shooting.

RULE 1.—REFEREE.

A referee shall be appointed by the contestants, or management, whose decisions shall be final.

RULE 2.—DUTIES OF REFEREE.

The referee shall see that the traps are properly set at the beginning of the match, and kept in order to the finish, and that they are kept properly filled. He may at any time, and must when so requested by a contestant, select one or more cartridges from those of a shooter at the score, and publicly test same for proper loading. If the cartridge, or cartridges, are found to be improperly loaded, the shooter shall suffer the penalty as provided in Rule 15.

RULE 3.—SCORER.

A scorer shall be appointed by the contestants, or management, whose score shall be the official one.

RULE 4.—PULLER.

A puller shall be appointed by the contestants, or management, and shall be placed at least 6 feet behind the shooter, and it shall be his duty to pull the traps evenly and fairly for each contestant, and instantly after the shooter calls "Pull." He must use a trap-pulling indicator, or other device that may be furnished by the management, so that the shooter will not know which trap is to be pulled. All traps must be filled before the shooter calls "Pull."

If more than one bird is liberated, the shooter may call "No bird;" but if he shoots, the result must be scored. Should the puller not pull in accordance with the indicator, he shall be removed and another puller substituted.

If the trap is pulled before, or at any noticeable interval after, the shooter calls "Pull," he can accept or refuse the bird; but if he shoots, the result must be scored.

RULE 5.—ARRANGEMENT OF TRAPS.

All matches shall be shot from five ground traps, placed 5 yards apart, in the segmeut of a circle. The radius of the circle shall be 30 yards from the shooter's score. The traps shall be numbered from No. 1 on the left to No. 5 on the right, consecutively.

NOTE.—A ground trap is one that lies flat with the surface of the ground when open, and gives the bird its natural flight in starting.

RULE 6.—THE RISE.

The rise shall be:
30 yards for 10-gauge guns.
28 yards for 12-gauge guns.
26 yards for 14 and 16-gauge guns.
25 yards for 20-gauge guns.
Shooter's feet must be back of, and not on shooting mark.

RULE 7.—BOUNDARY.

The boundary for both single and double bird shooting shall be the segment of a 50-yard circle and a dead line. The circle shall be drawn from a point 10 yards beyond the center trap on a line from the shooter's score, and it shall terminate where it joins the dead line, which shall be drawn at a distance of 30 yards from the center trap, and at right angles with a line drawn from the shooter's score to the center trap.

RULE 8.—BIRDS REFUSING TO FLY.

When a bird refuses to fly, such artificial means as have been provided by the management may be used to start it, by direction of the referee. A bird hit with a missile shall be declared "No bird." The shooter may declare a bird refusing to fly when the trap is pulled, "No bird." If a bird walks one yard toward the shooter it shall be declared "No bird" by the referee.

RULE 9.—GATHERING BIRDS.

A bird to be scored dead must be gathered within bounds before another bird is shot at, and within three minutes' time, by a dog or person appointed by the shooter for that purpose. No extraneous means shall be used, and no other person shall be allowed to assist in gathering. If the gatherer can not locate the bird, he may appeal to the referee to locate it for him. When the bird is retrieved by a man, it shall be scored dead when brought to firing point; but when dog is used, the bird shall be scored dead when the dog has had him in his mouth. All birds challenged must show flesh shot marks to be scored "Dead."

RULE 10.—BIRDS KILLED ON THE GROUND.

A bird killed on the ground with the first barrel is "No bird." But it may be killed on the ground with the second barrel if the first is fired while the bird is on the wing. If a bird is shot at on the ground with the first barrel, and the shooter uses the second barrel, and the bird escapes, it is "Lost Bird." But if the bird is killed, it shall be "No bird."

RULE 11.—MUTILATING BIRDS.

No mutilation of birds will be allowed, and if it is proved to the referee that any contestant has wilfully mutilated a

bird, or is a party thereto, the referee shall declare all his rights in the match forfeited.

RULE 12.—OUT OF BOUNDS.

If bird settles on top of boundary fence it must be scored lost. Where grounds are not enclosed and any part of bird is on the boundary line, after killing it shall be scored "Dead bird." Where fence is used for boundary and bird escapes through hole in same it shall be scored "No bird." A bird once out of bounds must be scored a "Lost bird," except where otherwise provided.

RULE 13.—BIRDS SHOT AT BY ANOTHER PERSON.

If a bird be shot at by any person other than the shooter at the score, the referee shall decide whether it shall be scored, or another bird allowed.

RULE 14.—POSITION OF GUN.

Any the shooter may adopt.

RULE 15.—LOADS.

Charge of powder unlimited. Charge of shot not to exceed one and one-quarter ounces American Association, or Dixon's measure, struck. Any shooter using a larger quantity of shot shall forfeit his entrance money and rights in the match.

RULE 16.—CALIBER AND WEIGHT OF GUN.

No gun of larger caliber than a 10-gauge shall be used, and the weight of all guns shall be limited as follows:

10-gauge, 9 pounds 4 ounces.
12-gauge, 8 pounds 4 ounces.
14 and 16-gauge, 7 pounds 12 ounces.
20-gauge, 7 pounds 8 ounces.

RULE 17.—LOADING GUN.

No gun shall be loaded except at the score. Cartridges must be removed from the gun before leaving the score.

RULE 18.—LOST BIRD.

If a gun is not cocked, or the safety not properly adjusted, and the bird escapes, it shall be scored a "Lost bird."

RULE 19.—BOTH BARRELS DISCHARGED SIMULTANEOUSLY.

If both barrels are discharged simultaneously and the bird escapes, the contestant shall be allowed another bird, same as provided in Rule 21. But if the bird is killed it must be declared "No bird."

RULE 20.—MIS-FIRE WITH THE FIRST BARREL.

If the shooter's gun mis-fire with the first barrel he shall be allowed another bird, but if he uses the second barrel and

misses, the bird must be scored "Lost bird." But if killed wiih the second barrel, on the wing, it shall be scored "Dead bird."

RULE 21.—MIS-FIRE WITH THE SECOND BARREL.

If a mis-fire occurs with the second barrel, the shooter shall have another bird, using a full charge of powder only in the first barrel. He must, however, put the gun to his shoulder and discharge the blank cartridge in the direction of the bird, and the bird must be on the wing when the first barrel is discharged.

RULE 22.—SHOOTER AT THE SCORE.

In all contests the shooter must be at the score within three minutes after his name is called to shoot, or he forfeits his rights in the match.

RULE 23.—LEAVING THE SCORE.

A shooter having fired his first barrel and left the score, can not return to fire his second barrel.

RULE 24.—BALK.

If a contestant is balked or interfered with, or there is other similar reason why it should be done, the referee may allow another bird.

RULE 25.—ANNOUNCING THE SCORE.

The referee shall announce the result of each shot distinctly and it shall be called back by the scorer, and at the close of each shooter's score the result must be announced, and if claimed to be wrong, the error, if any, must be corrected at once.

RULE 26.—TIE SHOOTING.

All ties shall be shot off at the original distance, and as soon after the match as practicable, at the following number of birds, unless otherwise agreed to by all contestants:

In matches of 10 birds or less, 3 birds.
In matches of 11 to 25 birds, inclusive, 5 birds.
In matches of 26 to 50 birds, inclusive, 10 birds.
In matches of 51 to 100 birds, inclusive, 25 birds.

If in a series of matches the result prove a tie, such tie shall be shot off at the original number of birds.

RULE 27.—CLASS SHOOTING.

All shooting shall be class shooting, unless otherwise stated.

RULE 28.—ENDANGERING PERSON OR PROPERTY.

If a bird shall fly so that to shoot at it would endanger any person or property, it shall not be shot at, and the referee shall allow another bird.

RULE 29.—FORBIDDEN SHOOTING.

No shooting shall be permitted within the enclosure other than at the score, and in case there is no enclosure, no shooting within 200 yards of the score, except by those at the score, without the consent of the management.

Double Birds.

RULE 1.

The rules for single bird shooting shall govern double bird contests, when not conflicting with the following:

RULE 2.—DOUBLE RISES.

The double rises shall be from two traps of any kind, 10 yards apart, pulled simultaneously. The rise shall be:

26 yards for 10-gauge guns.
24 yards for 12-gauge guns.
22 yards for 14 and 16-gauge guns.
21 yards for 20-gauge guns.

RULE 3.—ALLOWING ANOTHER PAIR.

Both birds should be on the wing when shot at. Should only one bird fly, the shooter shall have another pair of birds if he does not shoot, or if he does shoot and kills the bird on the wing. But if he shoots and misses, the bird shall be scored lost, and in such event he shall shoot at another pair of birds, with a full charge of powder only in one barrel. The referee shall load the gun, not allowing the shooter to know which barrel contains the full charge, and which contains the powder charge only.

RULE 4.—MIS-FIRE WITH THE FIRST BARREL.

If the shooter's gun mis-fire with the first barrel, he will be entitled to another pair of birds, if he does not shoot his second barrel. But if he fires his second barrel, the result must be scored, and the shooter will shoot at another pair of birds, with a full charge of powder only, in one barrel, as provided for in Rule 3.

RULE 5.—MIS-FIRE WITH SECOND BARREL.

If the shooter's gun mis-fire with the second barrel, the result of the first barrel must be scored, and the shooter shall

shoot at another pair of birds with a full charge of powder only in one barrel, as provided for in Rule 3.

RULE 6.—LOST BIRD.

If a shooter fire both barrels at one bird intentionally, it shall be scored "Lost birds." But if the second barrel be discharged accidentally, it shall be "No birds."

RULE 7.—NO BIRD.

If both birds are killed with one barrel, it shall be declared "No birds," and the shooter shall shoot at another pair of birds.

RULE 8.—TIES.

All ties must be decided in shooting off as follows:
In matches of 5 pairs or less, at 2 pairs.
In matches of 6 to 10 pairs, inclusive, at 3 pairs.
In matches of 11 to 20 pairs, inclusive, at 6 pairs.
In matches of 21 to 50 pairs, inclusive, at 10 pairs.

Rules Governing Rifle and Pistol Competitions.

By A. C. Gould.

RIFLE COMPETITIONS.

All meetings for competition shall be conducted by an Executive Officer, who shall see that the regulations are rigidly complied with by competitors and others. A record of the shooting shall be kept by a score-keeper seated in the rear of the firing point, who shall, as each shot is signaled, call in a loud voice the name of the competitor and the value of the shot, and, at the conclusion of the score of each competitor, announce in like manner his name and total score. Competitors shall be allowed to examine the records of the score-keeper during the progress of the match, but in such manner as not to interfere with his work.

RIFLES.

Any rifle is allowed in the competition, with sights of any description, excepting such as cover the target, so as to conceal the danger signal when displayed.

TARGETS.

The following described targets are now in general use:

GERMAN RING TARGET.

Bull's-eye, 12 inches. The whole target, including bull's-eye, divided into circles ¾ inch apart, the center circle being 1½ inches, and counting from 25 down to 1.

STANDARD AMERICAN TARGET, 4 x 6 FEET.

Count	10.	Bull's-eye,	circular,	3.36	inches	diameter.
"	9.	"	"	5.54	"	"
"	8.	"	"	8.00	"	"
"	7.		"	11.00	"	"
"	6.		"	14.80	"	"
"	5.		"	19.68	"	"
"	4.		"	26.00	"	"
"	3.		"	34.22	"	"
"	2.		"	46.00	"	"
"	1.		"	4 x 6	"	"

For rest shooting add circle inside of ten 2.33 inches in diameter; inside of eleven circle add another circle, 1.41 inches in diameter; these circles count 11 and 12 respectively.

COLUMBIA TARGET.

Bull's-eye, 12 inches. The whole target, including the bull's-eye, divided into circles ½ inch apart. The center circle, being one inch in diameter, counts 1, the second circle counts 2, and so on out to 26. A shot outside the 26 circle counts 27.

MARKING AND SCORING.

The marker in the pit shall signal the location of a shot by placing a disk over the shot hole, after which he shall display a card on which is a figure indicating the value of the shot.

POSITION.

In off-hand shooting, the position up to and including three hundred yards shall be standing. The elbow may be rested against the hip or the body.

At distances above three hundred yards any position may be taken without artificial rests to the rifle or body.

TIES.

Ties shall be decided as follows, viz.: The score containing the lowest shot shall rank lowest; in re-entry matches to be decided by the next highest score or scores, if still a tie, by inverse order of shots; and, if still a tie, by each competitor shooting three shots, until decided.

No scores with handicap shall exceed a perfect score.

Pistol and Revolver Competitions.

PISTOLS AND REVOLVERS PERMISSIBLE.

Any of the following conforming to the conditions prescribed.

Army or navy revolvers. Such in all respects as have been adopted by any government for the armament of its army or navy.

Target revolvers. Of any caliber, maximum weight three pounds, maximum length ten inches, including cylinder.

Any pistol. Breech or muzzle-loading, maximum weight three pounds, maximum length of bore ten inches.

Minimum trigger pull shall be four pounds for military revolvers, two and one-half pounds for target revolvers and two pounds for single shot pistols.

As to sights, the front and rear sights must be open, and not more than ten inches apart; the notch of a rear sight, to be considered open, must be as wide at the top of the notch as at any part; no aperture or peep sights, nor any manner of covered sights, shall be permitted. Lateral sliding bars or wind gauge may be used on rear open sight of target revolvers or single shot pistols, also any elevating front or rear open sight. Sights on military revolvers must be unaltered. The use of a notch for a front sight will not be permitted. Sights may be smoked or blackened in any desired manner.

AMMUNITION.

If factory ammunition is called for, it shall be of any make, of any established manufacturer, generally procurable in stores and brought to the shooting-point in unbroken boxes, with the label of the manufacturer intact.

CLEANING.

In any match where both pistols and revolvers are allowed, competitors may clean their arms at will, provided such cleaning does not delay the firing, which shall be at the rate of one shot per minute, when time limit is required, or oftener during the firing of each score, except in case of accident. In such case the time may be extended, in the discretion of the Executive Officer.

In matches confined to revolvers, the cylinder must be fully charged, or a sufficient number of chambers charged to complete the score. Blowing into or cleaning the barrel in any way will not be permitted, except when the cylinder is completely discharged.

LOADING AND FIRING.

No arms shall be loaded except at the firing-point, the muzzle of piece being kept in the direction of the target till the arm is either discharged or unloaded.

Mis-fires shall not count; but an accidental discharge shall, in every instance, be scored a shot.

POSITION.

The position shall be as follows: Standing free from any other artificial support, the pistol or revolver held in one hand only, with the arm extended free from the body, and unsupported in any way.

TARGETS.

The Standard American target, full size, having an eight-inch bull, shall be used in matches at fifty yards distance. The same target, reduced to one-half size, having a four-inch bull, in matches at thirty yards' distance. The same target reduced to one-quarter size, having a two-inch bull, in matches at twenty yards' distance. The target reduced, in the same proportion to distance, in matches of a lesser range.

MARKING AND SCORING.

Unless otherwise specified, each competitor will have a separate target provided, and will fire his score throughout, when the target will be examined by the scorer and the score recorded.

VALUE OF SHOTS.

If a bullet touches in a line the count of that line is given; shots on or within that line count the same. The eye alone shall determine the count. Placing a bullet or other articles in the shot-hole is not permitted.

APPEAL.

In case of a challenge or of dissatisfaction in any way connected with the shooting, in matches or practice, being referred to the Executive Officer, he or his representative shall render a decision. Should his decision be unsatisfactory, an appeal may be made in writing to the Executive Committee; the decision of the majority of this committee shall be final.

TO AVOID DANGER.

No unnecessary talking will be allowed to or by shooters while on the firing point with loaded pistol.

How to Organize a Gun Club and Conduct a Tournament.

By Jack Parker.

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TO ORGANIZE A GUN CLUB.

1. When a party of shooters or sportsmen desire to organize a Gun Club, a few of the leading spirits should appoint a time and place for a meeting, and invite all interested to be

present. A gun or sporting goods store is an excellent place to meet. The meeting should be called to order by one of the promoters, and a Chairman and Secretary should be elected to act until a permanent organization is effected. After the object of the meeting has been sufficiently discussed, and all present who desire to become members of the proposed Club have given their names, a committee of three or five should be appointed to suggest a name for the Club and to draft a Constitution and By-Laws for permanent organization, the committee to have authority to call a meeting again when ready to report. At the second meeting action should be taken on the report of the committee, and the organization be completed by electing officers. A committee should be appointed to secure suitable grounds, to prepare same and to purchase traps, targets and whatever is necessary for an outfit. This committee may have power to act, or may be required to report all proposed purchases and arrangements for the approval of a meeting before completing same. The Secretary should be instructed to send notice at once to the press of the organization of the Club.

2. A Constitution should in general embrace the following subjects: Name of club, object, officers and method of electing same, duties of officers, conditions of membership and method of electing to same, fees, initiation and annual method of dealing with members in arrears, how membership may be terminated, forfeiture of rights and interests, how the Constitution may be amended.

3. By-Laws should pertain to time of meeting, order of business, regulations for shoots, management of ground, purchase of supplies, reports and auditing of same, and whatever the individual club may find its peculiar circumstances may require.

4. The following are the customary officers and their duties: A President, whose duties are to preside at meetings, enforce order and the rules of the Club, and exercise a general supervision of its affairs; a Vice-President, who acts in the absence of the President; a Secretary, who keeps a record of the membership and the proceedings of meetings, issues notices and attends to correspondence; a Treasurer, who collects and disburses funds on order of the Club, and is expected to attend to ordinary purchases; a Captain, who has the management of shoots and the enforcement of rules on the grounds. It may be well to appoint the officers as an Executive Board or committee to settle all questions and attend to all matters of not sufficient importance to call a meeting of the whole Club.

5. It is important to have a good live man as Secretary, who will keep the papers informed of the scores and doings of

the Club. This keeps the members pleased and interested, and attracts the attention of the sporting fraternity in general, which is of value.

TO CONDUCT A TARGET TOURNAMENT.

1. Grounds should be as level as possible, with unobstructed sky as background. Cashier's office or tent should be central and 30 yards or more from shooting scores. Shelter for shooters when in action or resting, tables or racks for guns and plenty of chairs or benches should be always provided. The shooting score should be roped off and no person allowed inside but the shooters at the score, the squad immediately to follow and those whose duty require their presence. Spectators should be arranged on the right or left, or immediately in the rear of shooting scores.

2. Arrangement of traps should be according to American Association rules: Five traps five yards apart, or the W. G. Sergeant System, three traps four feet apart. Pit for trappers, three feet deep and eight feet long, with screen to protect nine feet long and three feet high. The shooting scores should be five in number, two yards apart, circular in form and sixteen yards from center trap; five to constitute a squad. Each contestant fires, in ten-bird event, twice before moving; in fifteen-bird event, three times, and so on, according to number of targets in event, shooting always at known trap and unknown angle. This arrangement is commended as the most pleasing and satisfactory in results.

3. Targets enough for the entire day's shoot should be unpacked, and conveniently placed before the tournament begins, in order to avoid delay and confusion later on. They should not be exposed to rain or to the sun on a hot day. Each target should be tried before placing in trap by pulling in opposite directions.

4. The manager should be a man of experience, able to instruct and direct his assistants, settle all disputes, prevent friction and keep up the general interest.

5. The referee should have good eyes and good judgment, and should be familiar with trap shooting. He should stand to the right or left of shooters near the scorers, and should call "dead" or "lost" distinctly, so that contestants and scorers can plainly hear. His decisions should be final.

6. The cashier has a very trying and responsible position. He should be courteous, of even disposition and not easily excited. He should also be a good penman and accountant. He should make all entries in a cash book, should record all totals of scores on a separate card or book, receive and pay out all moneys, and be personally responsible for the cash. He

should, before opening up, provide himself with plenty of change (say $25.00 worth), pencils, clips, files and writing material.

7. The assistant cashier should transfer names from cash book to score sheets, check the totals of scores received from scores, verifying same, furnish newspaper reporters with scores, keep the scores in order, each event by itself and according to number of squad, and assist the cashier in every way.

8. The squad hustler should exert himself to give prompt movement to the various events, should receive score sheets from the assistant cashier, place names on blackboard, call up squad and see that each man is in his place, hand score sheet to scorer, and then proceed in same way to get next squad in readiness. When he hands to scorer the score sheet of second squad, he should receive from him the score sheet of first squad and compare its scores with those on the blackboard. If found correct he should pass it to the assistant cashier, at the same time receiving from him the score sheet for next squad. If score sheet and blackboard do not agree, he should stop the shooting, call the attention of the referee and the individual interested, and, if necessary, the manager, to the discrepancy, and require an adjustment.

9. The scorers should make faithful record of all "dead" or "lost" birds, as called out by the referee. There should be two scorers, one to record on score sheet and one to record on blackboard; or, if there is no blackboard, each to record on separate score sheet. They should be near each other, should keep their eyes off the targets and on their work, and should take turns in calling back to the referee, to show that they have heard correctly.

10. The trap puller should be situated about two yards behind No. 3 score, and should watch each shooter closely, so that he may both see and hear him call. He should promptly pull, the instant the call is made, as the failure to do so is sure to disturb the shooter.

11. The trappers should be strong, active, young men, and carefully instructed in placing targets and operating traps. They should keep the tension springs on carriers carefully adjusted so as not to break targets because too tight, or to let them fall out because too loose. They should also keep working parts oiled, and should be sure that targets are not cracked or imperfect.

12. Added money is an attraction to a tournament, and contributes much to its success now-a-days, though formerly it was not thought necessary. It is, however, liable to abuse, and often results in driving the smaller clubs out of the tournament,

because not able to afford this extra money. A medium course should be adopted where clubs can not afford to add to purses, such as guaranteed purses with surplus added. A liberal guarantee would probably have the same effect in interesting shooters as added money.

13. Division of moneys is an important consideration. The Rose system tends to the equalization of moneys, but takes away the chance of winning a big purse alone, for which all shooters strive. It has the merit, however, of preventing, to considerable extent, "dropping for place," that bane of all tournaments. "High guns" is another way of dividing purses. But the percentage system is generally preferred, which consists of a division of the whole into five parts, of the following per cents, 30, 25, 20, 15 and 10.

14. Handicaps may be imposed by means of added birds, varying distances and styles of shooting. This method of conducting a tournament meets with favor or disfavor according to the locality. In determining its advisability in a given case, there should be taken into account the general sentiment prevailing among shooters in the section where the tournament is to be held.

15. Style of shooting should be to imitate as far as possible live bird or field shooting. Machine-like methods should be broken up, both barrels should be brought into action and the "unexpected" should be an important element. Wherever it can be introduced, there should be one or more events each day requiring targets at eighteen to twenty-one yards rise, unknown traps and angles, and the use of both barrels.

16. The programme should be printed in neat and tasty manner, and should contain information as to how to reach the grounds, rules, conditions, handicaps, styles of shooting, prizes, purses, and whatever may be useful to attendants at the tournament.

17. In general:

American Association Rules should govern.

"Dropping for place" should be strictly prohibited.

Good luncheon should be furnished on grounds, or good meals if hotel is near by.

Score sheets should be on paper which will allow of manifolding by means of carbon paper, as it is quite necessary to furnish scores to the press.

Each blackboard should be large enough for two squads to be entered thereon, with space enough to score 25 targets.

Shells should be for sale on the grounds.

There should be on hand, chalk, sponges for erasing, hammer, monkey wrench, screw driver, extra carriers, main springs,

and whatever might be necessary for prompt repairing of traps.

Everything should be done to secure large attendance, but the real success of a tournament depends upon good order, the fairness, smoothness and dispatch with which the various events are conducted and the faithful carrying out of all promises.

To Conduct a Live Bird Tournament.

Much that has already been said in relation to the Target Tournament will also apply in this case. Nor is it necessary to repeat the general rules observed by the American Association in Live Bird Shooting. A few words only of special advice will be offered.

1. The grounds should be as level as possible and large enough for a fifty-yard boundary. There should be an open sky to shoot against. The boundary should be distinctly marked by stakes or flags, or, better still, by a low wire fence, in that it prevents birds that strike inside from bounding out. Spectators and those not actually employed in running the tournament should be kept at a good distance to the rear or side. The shooter should be entirely isolated, and no loud talking or remarks pertaining to him while at the score should be permitted by the referee, who has power in such matters.

2. Traps and method of trapping vary considerably. Ground traps, of which there are several different styles, give general satisfaction. The method of trapping in favor at a number of the principal shooting parks is what is called the Elliott underground system. It is thought to work smoothly and expeditiously. The trappers and birds are located in an underground chamber or cellar. The trapper loads the trap from underneath through a hole in the bottom of the trap. The dead birds are retrieved by a dog or boy from the score.

Another method of trapping, and which is meeting with favor, is that recently introduced by E. D. Fulford. A pit is made three feet deep, five feet wide and about twelve feet long, and is situated between and just back of Nos. 2 and 3 traps. To prevent shot from striking downward into the pit, a board a foot high can be placed back of the pit and banked up with earth in a sloping manner. Two boys or men with a crate of birds can lie in the pit and trap and retrieve from them. A bell or gong can be arranged near the edge of the pit with a rope leading back to the score, and trappers can be notified from there, by ringing same, when to load trap and when to retrieve. This system, with regulations carefully observed, is free from danger and is saving of time and labor.

Where a club can not afford the first-named system, or has not grounds suitable for the second, the old style can be used, the trapping and retrieving being done from the score. A good fast dog retriever is better than a boy or man; but when a dog is not available, two good active boys are necessary, one to load trap and one to retrieve.

3. The handling of birds is an important matter. The birds should be kept in a large roomy place, with plenty of light. The place should be kept clean, and gravel should frequently be scattered on the floor. The birds should have plenty of water and food until about eighteen hours before the shoot takes place, when they should be deprived of food. They should be carried to the shooting grounds in good sized crates, and should be taken from crates to traps by the trapper, with the ends of both wings, the tail and feet held in his hands.

No mutilation of birds should be allowed, and all wounded birds should be immediately killed. The dead birds should be laid on their backs, and when the weather is warm a few feathers should be plucked near the tail. Dead birds should never be piled in a heap, even if placed in a cooler or refrigerator, until the animal heat has left their bodies.

4. In regard to methods of shooting, where there is a large number of entries, the event can be shot in squads, each squad shooting entirely out before the next squad begins. But this is generally considered unfair, as the weather conditions may change before the shoot is over, thus favoring some at the expense of others. The better way is, for each shooter to take his turn, and so on, through all the entries, until an event is finished.

No outside shooting at escaped birds should be allowed, except by permission of the referee or manager.

A blackboard is not necessary in live bird shooting; but scores should be manifolded, so that copies can be sent to the press.

5. In awarding prizes, high guns, or miss and out, are generally conceded the best, and are the most popular methods of dividing purses. The method of class dividing is not generally regarded with favor, as it cuts the money into too small portions.

Hints to Beginners on Guns and Game.

By Jack Parker.

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CHOOSING A GUN.

In selecting a gun, regard should be had for the kind of shooting to be done. For field shooting, 16 or 12-gauge

guns are the most popular. The barrels should be from 26 to 30 inches in length. One barrel should be cylinder, the other moderate choke. Weight of gun, 6 to 7½ pounds. For trap shooting, the 12-gauge gun is in universal use. Both barrels should be full choke, and 28 to 30 inches in length. Weight of gun, 7½ to 7⅞ pounds. For duck shooting, 12 or 10-gauge guns are used. Length of barrels, 30 to 32 inches, both full choke. As to weight of guns for this purpose, the heavier the better.

HUNTING.

1. In shooting at ducks over decoys from a point or blind, always have the wind at your back, or blowing sideways across your decoys. Never, if you can help it, have the wind in your face, as the ducks have to light against the wind, and therefore will not come into decoys with the wind. In lying out on open water, always lie to windward of decoys. In paddling on ducks in open water, always go down with the wind, as they have to rise against the wind, and you will then be enabled to get a nearer and better shot.

2. In punting ducks, such as mallard, wood duck, teal, etc., in rice beds or marshes, it is better to punt against the wind, so that they may not hear your approach. Live decoys are much better than wooden ones for mallard shooting. A retriever is necessary for marsh shooting in a boat, and the Irish water spaniel is the best dog for such purpose, because he is a smaller dog, is not so heavy and does not bring so much water into the boat.

3. In hunting snipe, go with the wind, as they have to rise against the wind, and will quarter past you, thus giving a much easier shot than if flying straightaway, on account of their twisting and erratic flight. A good retriever, that will stay well at heel, is necessary for snipe shooting.

4. In hunting partridge or ruffed grouse, do not look for them on burnt or barren ground. They are generally found in brush or thickets, where clover is growing, and on the sunny side on a frosty morning. Clover, winter green and wild grapes or berries are their favorite food. Do not hunt earlier than 8:30 in the morning. Never send a dog to retrieve until you have reloaded your gun.

5. In hunting quail, seek stubble field, buckwheat patches, and old corn fields with a thicket or cover near by. Work your dog as much as possible against the wind. In flushing a bevy, always take pains to mark down well the scattered birds, and do not be in too much hurry to follow them up, as they lie very close just after being flushed. After a little while they will commence to run together, and can be easily found by the dog.

Quantities of Black Powder and Different Sizes of Shot in Loaded, Paper Shells, Best Adapted for Various Uses.

12-GAUGE GUN.

Amount of Powder.		Amount of Shot.		Size Shot.	Adapted to Shooting.
3	Dr.	1	Oz.	10	Woodcock.
3¼	"	1⅛	"	9	Snipe.
3¼	"	1	"	8	Quail.
3¼	"	1⅛	"	8	Quail and Prairie Chicken.
3½	"	1⅛	"	8	Prairie Chicken.
3	"	1¼	"	8	Inanimate Targets.
3¼	"	1¼	"	8	Inanimate Targets.
3½	"	1¼	"	8	Live Pigeons.
3¼	"	1¼	"	7	Clay Pigeons.
3¼	"	1⅛	"	7	Ruffed Grouse.
3½	"	1⅛	"	7	Teal.
3½	"	1¼	"	7	Live Pigeons.
3¼	"	1⅛	"	6	Bluebill.
3½	"	1⅛	"	6	Pintail.
3½	"	1⅛	"	5	Mallard.
3¾	"	1⅛	"	4	Red Head.
3¾	"	1⅛	"	3	Canvas Back.
4	"	1⅛	"	2	Turkey.
4	"	1⅛	"	1	Brant.
4	"	1⅛	"	B. B.	Goose.

10-GAUGE GUN.

Amount of Powder.		Amount of Shot.		Size Shot.	Adapted to Shooting.
4	Dr.	1⅛	Oz.	10	Woodcock.
4	"	1⅛	"	9	Snipe.
4	"	1⅛	"	8	Quail.
4¼	"	1⅛	"	8	Quail and Prairie Chicken.
3¾	"	1¼	"	8	Inanimate Targets.
4	"	1¼	"	8	Inanimate Targets.
4½	"	1¼	"	8	Inanimate Targets.
4½	"	1¼	"	8	Live Pigeons.
4¼	"	1¼	"	7	Clay Pigeons.
4¼	"	1⅛	"	7	Ruffed Grouse.
4½	"	1⅛	"	7	Teal.
4½	"	1¼	"	7	Live Pigeons.
4¼	"	1⅛	"	6	Bluebill.
4½	"	1⅛	"	6	Pintail.
4½	"	1⅛	"	5	Mallard.
4½	"	1⅛	"	4	Red Head.
4¾	"	1⅛	"	3	Canvas Back.
5	"	1⅛	"	2	Turkey.
5	"	1⅛	"	1	Brant.
5	"	1⅛	"	B. B.	Goose.

To secure the best results, two thick felt wads, one cardboard wad over the powder, and one thin cardboard wad over the shot should be used.

Directions for Using Dynamite.

STORAGE.

Store and ship Caps separately from Dynamite. You need not fear accidents if this rule is observed.

THAWING.

Dynamite is very sensitive to cold, and freezes at 42 degrees Fahrenheit, and when in a frozen or chilled state, will not explode; but should a partial explosion result, it will be unsatisfactory and ineffective; therefore, it must be thoroughly thawed before using.

Most serious casualties have resulted from thawing Dynamite improperly. IT MUST BE DONE SLOWLY.

Never attempt to thaw it near any open fire, or in a stove oven.

A very simple and safe process is to place your Dynamite in an ordinary tin bucket, and then place the bucket in a tub of hot water, not permitting the water to overflow the bucket, wetting the Dynamite. Then by covering the whole with a folded horse blanket, the heat of the water will be retained for a long time, and thoroughly thaw your powder. As it requires a heat equal to 360 degrees Fahrenheit to explode Dynamite, and as boiling water only reaches 212 degrees Fahrenheit, this method commends itself.

General Directions.

In the first place, always see that your Cartridges are THOROUGHLY THAWED. Please observe remarks under the head of "Thawing."

The charge should fill the diameter of the hole. When a number of Cartridges are used in the same charge, the last or top Cartridge should contain the Cap or Exploder, with Fuse attached.

When only one Cartridge is used, a piece of Cartridge a couple inches in length, with Cap or Exploder attached, should be placed firmly on the top of the charge as a PRIMER. To prepare said primer, cut the Fuse straight across the end, insert it in the cap, then crimp the cap tightly around the Fuse. Open the end of the Cartridge, and with a pointed stick, punch a hole in the Dynamite. Then insert the cap with the Fuse attached, leaving at least a quarter of an inch of the Cap above the surface of the Dynamite. Never insert your Cap in the side of the Cartridge, as in that case, it is liable to set fire to the upper portion of the Cartridge, thereby destroying a large portion of the force of the charge.

Fasten the fuse tightly with a string, tied around the Fuse and Cartridge, in order to retain the Cap and Fuse in their proper position. (See cut.)

Then lower the Cartridge into the hole, gently pressing it home. Then place in the hole about four inches of clay or sand, after which fill the hole entirely with hard tamped earth. DO NOT USE IRON IN TAMPING, as wood answers just as well, or better, therefore its use is recommended.

It is important to use good Caps and Fuse. Tape Fuse is recommended, as it resists the force of tamping and the influence of moisture, and never, under any circumstances, attempt to use a weak, cheap Cap. Even if an explosion occurs, its strength is reduced by a weak Cap.

Great care should be exercised in handling the Caps, and they should not be stored, carried, packed or shipped with Dynamite.

UNDER WATER BLASTING.

For work of this character always use WATER-PROOF FUSE. To prevent the water destroying the fulminate in the Cap, the joint where the Fuse enters the Cap, as well as the end of the Cartridge, where the Cap is inserted, must be made water-tight, with soap or tallow, or grease of some sort. The water, however, will NOT INJURE the Dynamite.

FOR SHOOTING WELLS.

In dry seasons, there is always great difficulty in obtaining sufficient water from wells. This defect can nearly always be remedied by what is termed "shooting a well." After a well has been dug to a sufficient depth, and no water found, or at least an insufficient supply, a continuous flow may be gained by exploding a charge of Dynamite at the bottom of the well. This will loosen the seams in the rock, and cause an adequate supply of water. The mode is quite simple, adopting the directions for blasting under water.

WARNING.

It occasionally happens that a blast will fail to explode, on account of the Cap or Fuse being defective, or either becoming disconnected from the Cartridge, or again when the Cartridges are frozen. NEVER ATTEMPT to bore or drill out the charge, but carefully clear out the hole to within about eight inches of the old charge, and place a fresh Cartridge, or a piece of one,

in the hole, and fill it up again. This method will explode the original charge below.

STUMP BLASTING.

In placing the charge under a stump, observe the nature of the ground, and the size and direction of the roots. Then place the Dynamite in position to create the greatest force against the strongest part of the stump, in heavy soil, go deep down among the roots; but in light soil, bore into the stump, or close under the bottom of it. Always use Dynamite enough to do the work well. Where several holes are charged, all coming close together under the stump, one primer of a single Cartridge in one of the holes will explode the balance. For directions for charging the holes, and making the primers, see instructions under the head of "General Directions." For throwing out pine stumps in light soil, it will be necessary to use a larger charge than when blowing out either soft or hardwood stump in heavy soil. As previously stated, use plenty of powder, and do not expect too much. A big solid stump requires a charge of something like three pounds, but after a little experience in the work of throwing out stumps, you will be able to decide the amount of Powder yourself much better than can be described in this book.

WHAT DYNAMITE IS AND HOW IT IS MADE.

Few people know what dynamite is, though the word is in common use. It is a giant gun powder, that is, an explosive material, varying in strength and safety of handling, according to the percentage of nitro-glycerine it contains. Nitro-glycerine, whence it derives its strength, is composed of ordinary glycerine and nitric acid, compounded together in certain proportions, and at a certain temperature. Nitro-glycerine, though not the strongest explosive known, being exceeded in power by nitrogen and other products of chemistry, is thus far the most terrible explosive manufactured to any extent. Nitro-glycerine by itself is not safe to handle, hence dynamite is preferred. It is extensively made and consumed in this country under the various names of Giant, Hercules, Jupiter and Atlas Powders, all of which contain anywhere from 30 to 80 per cent. of nitro-glycerine, the residue of the compound being made up of rotten stone, non-explosive earth, sawdust, charcoal, plaster of paris, black powder, or some other substance that takes up the glycerine and makes a porous spongy mass.

Nitro-glycerine was discovered by Salvero, an Italian chemist, in 1845. Dynamite is prepared by simply kneading with the naked hands 25 per cent. of infusorial earth and 75 per cent. of nitro-glycerine until the mixture assumes a putty con-

dition, not unlike moist brown sugar. Before mixing, the infusorial earth is calcined in a furnace, in order to burn out all organic matter, and it is also sifted to free it of large grains. While still moist it is squeezed into cartridges, which are prepared of parchment paper, and the firing is done by fulminate of silver in copper capsules provided with patent exploders.

Nitro-glycerine is made of nitric acid one part and sulphuric acid two parts, to which is added ordinary glycerine, and the mixture is well washed with pure water. The infusion is composed of small microscopic cilicious shells, which have lost their living creatures. The cellular parts receive the nitro-glycerine and hold it by capillary attraction, both inside and out. The earth is very light. Water is expelled from it by means of a furnace, and then, in the form of a powder, it is mixed with nitro-glycerine. Nitro-glycerine has a sweet, aromatic, pungent taste, and the peculiar property of causing a violent headache when placed in a small quantity on the tongue or wrist. It freezes at 40 degrees Fahrenheit, becoming a white, half crystallized mass, which must be melted by the application of water at a temperature of about 100 degrees Fahrenheit.

Foreign Patent Laws.

CONDENSED STATEMENT OF THE CONDITIONS AND FOR MALI TIES REQUIRED IN THE PRINCIPAL INDUSTRIAL COUNTRIES FOR OBTAINING A PATENT OF INVENTION.

Canada.

(NOT A MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The inventor, his executor, administrator, or assign. Application must be made by the inventor, if living.

PATENTABLE INVENTIONS.

Any new and useful art, machine, manufacture, or composition of matter or any improvement on any art, machine, manufacture, or composition of matter not known or used by others before the invention thereof by the applicant and not in public use or on sale for more than one year previous to the application in Canada, with the consent or allowance of the inventor.

An inventor who has patented his invention in a foreign country may obtain a patent in Canada if he applies within a year from the date of the issue of said patent. Notice to the

Commissioner of intention of applying for patent, if given within three months from the date of the issue of foreign patent, entitles the inventor, after applying for and obtaining such patent, to prevent further manufacture of his invention by any person who may have commenced such manufacture during the year following the issue of the foreign patent and preceding the application for the Canadian patent.

In all cases the Canadian patent expires at the earliest date on which any foreign patent expires.

INVENTIONS EXCLUDED FROM PROTECTION.

All inventions having an illicit object in view or consisting in any mere scientific principle or abstract theorem.

NATURE AND DURATION OF THE PATENT—TAXES,

Patents are granted for eighteen years; but it is optional with the applicant whether he shall pay for the whole term or only for six or twelve years, with permission to renew.

Fees:

Full fee for eighteen years	$60
Partial fee for twelve years	40
Patial fee for six years	20
Fee for further term of twelve years	40
Fee for further term of six years	20
Lodging a caveat	5

APPLICATION—FORMALITIES AND DOCUMENTS.

The application must be accompanied by an oath or affirmation to the effect that the applicant believes himself to be the original inventor. If applicant is a foreigner, he must elect domicile at some place in Canada.

There must also be given title of invention, specification in duplicate (specification shall correctly and fully describe mode of operation and clearly state features claimed, shall bear the name of the place where made, aud be signed by inventor or legal representative and two witnesses), when necessary, drawings, in duplicate, in black ink, on tracing-linen, eight by thirteen inches, signed by applicant or attorney; also, extra drawing on bristol board, same size, but not necessarily giving all the figures, only the one giving the best general idea of the invention; no writing on the face, no title, certificate, or signature, but on the back of the sheets the inventor's name and title of invention in pencil. Oath may be made before any person authorized to administer oaths in the locality where it is made.

THE GRANT—WORKING.

Preliminary examination with reference to the formalities of the application and novelty and patentability of the invention.

The invention must be worked in Canada within two years from the date of the patent. Articles may be imported for one year only, unless extension of privilege is asked for. Such extension is limited to one year.

France.

(MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

Any person who makes application therefor may obtain a patent for any new discovery or invention in any class of industry.

PATENTABLE INVENTIONS.

The invention of new industrial products.

The invention of new means or the new application of known means for obtaining an industrial result or product.

No discovery, invention, or application which in France or abroad and previous to the date of the filing of the application has received sufficient publicity to enable it to be carried out will be considered new, except in case of applications made in compliance with the terms of the International Convention.

INVENTIONS EXCLUDED FROM PROTECTION.

First.—Pharmaceutical compositions or remedies of all kinds.

Second.—Plans and combinations of credit or finance.

NATURE AND DURATION OF THE PATENT—TAXES.

First.—Patents of invention. Duration, five, ten or fifteen years, to start from the filing of the application.

Second.—Certificates of addition. Same duration as that of the principal patent to which they refer.

The duration of patents granted for inventions already patented abroad cannot exceed that of such patents granted abroad.

Taxes: First, patents of invention, 100 francs a year; second, certificates of addition, single tax of 20 francs.

Franc—$0.193.

APPLICATION—FORMALITIES AND DOCUMENTS.

The applicant for the patent must file, under seal, at the office of the secretary of the prefecture in the Department in which he resides, or in any other Department which he elects as domicile—

First, his application to the Minister of Commerce, Industry, Posts and Telegraphs;

Second, a description of the discovery or invention;

Third, the drawings or samples necessary for understanding the description;

Fourth, a memorandum of the documents filed.

The application must be limited to a single principal subject, including the details which it comprises and the uses to which it may be applied. It must mention the duration assigned to the patent and indicate a title, closing with a summary and precise designation of the subject of the invention. The description must be written in French. The denomination of weights and measures must be in the decimal system.

The drawings must be line drawings, in good black ink, according to the metric scale. They need not be signed.

A duplicate of the description and the drawings must be joined to the application.

All the documents must be signed by the applicant or his representative, whose power of attorney must accompany the application.

The application will be received only on the production of a receipt for the payment of the first annuity of 100 francs, at Paris, at the office of the Central Receiver of Finances of the Seine or in the Departments at the office of the receivers of finance.

A certificate of the filing is sent to the applicant on receipt of the price of the stamp.

MODELS.

The applicant may file a model if he thinks it necessary to the understanding of the invention.

THE GRANT.

When the application has been regularly prepared, the patent is issued, without preliminary examination, at the risk and peril of the applicant, and without guarantee either of the reality, the novelty, or the merit of the invention or of the fidelity or exactness of the description.

WORKING.

Patented invention must be worked in France within two years from grant of patent, and must not be discontinued for more than two years.

Germany.

(NOT A MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The patent is granted to the inventor or his assignee.

Persons not residing in Germany must appoint a resident representative.

Models of Utility, (Gebrauchsmuster.)

The model of utility is registered for the benefit of the first applicant.

A person having neither residence or establishment in Germany can claim legal protection only when it has been published in the *Reichs-Gesetzblatt* that German models of utility enjoy legal protection in the country where he has his domicile or establishment. In depositing his model such person must appoint a representative in Germany.

PATENTABLE INVENTIONS.

New inventions that are susceptible of industrial use.

An invention which at the time of filing of the application has already been described in printed publications anywhere within the last century, or which has already been used in the country in a sufficiently public manner for those skilled in the art to be able to work it, will not be considered new.

Models of Utility, (Gebrauchsmuster.)

The law protects as models of utility working tools or inventions designed for practical use, or their parts, in so far as by a new configuration, a new arrangement, or a new mechanism they may serve for work or practical use.

Models will not be considered new which at the time of the application were already described in printed publications, or had already been notoriously utilized in the country.

INVENTIONS EXCLUDED FROM PROTECTION.

First.—Inventions, the use of which would be contrary to the laws or to good morals.

Second.—Inventions of food products, objects of consumption (*Genussmittel*), and medicines, as well as materials obtained by chemical means, in so far as these inventions do not relate to the process of manufacture.

NATURE AND DURATION OF THE PATENT—TAXES.

Two kinds of patents:

First.—Patents of invention. Duration, fifteen years, to start from the day following the date of filing the application.

Second.—"Patents of addition." Granted for the remainder of the term of the principal patent. May become in effect a principal patent if the principal patent for any cause becomes void.

Application fee, 20 marks; first annuity, 30 marks; second annuity, 50 marks; third annuity, 100 marks, and so on, with an annual increase of 50 marks.

"Patents of addition" pay only the filing fee and first annuity.

Models of Utility, (*Gebrauchsmuster.*)

The applicant receives a certificate of registry.

The duration of the protection is three years, to start from the date following the date of filing, and may be extended three years more.

Filing fee, for the first three years, 15 marks. Fee for extension, for the following three years, 60 marks.

Mark=$0.238.

APPLICATION—FORMALITIES AND DOCUMENTS.

First.—Application for a patent, addressed to the Imperial Patent Office.

Second.—Description of the invention, in duplicate, written on paper thirty-three by twenty-one centimeters.

Third.—(*a*) A drawing (or several) on bristol or card board, drawn in india-ink, without color or wash: (*b*) a tracing on muslin of the above drawing, which may be colored. Dimensions of the drawings of the two kinds: Thirty-three centimeters high by twenty-one wide, or thirty-three centimeters high by forty-two wide, or thirty-three centimeters high by sixty-three wide. A single line traced two centimeters from the edge must surround the drawings. Within this line, at the top, a space of three centimeters in height must remain free. The lower right hand corner must receive the signature of the applicant or his representative.

Fourth.—A power of attorney, not authenticated, if the application is filed by representative.

Models of Utility, (*Gebrauchsmuster.*)

First.—A declaration addressed to the Imperial Patent Office containing—

(*a*) An application for registry;

(*b*) The title under which the model is to be registered;

(*c*) A statement of the new configuration or new mechanism to be protected;

(*d*) The declaration that the fee of 15 marks has been paid to the treasury of the Patent Office, or that it will arrive at the same time with the declaration;

(*e*) The name, profession, and residence of the applicant, if the filing is done by representative;

(*f*) The list of the annexes;

(*g*) The signature of the person effecting the filing, with statement of his profession and residence.

Second.—A picture or reproduction of the model. The picture (drawing, photograph, etc.) must be on bristol or card board thirty-three by twenty-one centimeters, or on tracing-

muslin not over thirty-three centimeters each way. The reproduction must not exceed fifty centimeters in each dimension.

Third.—A power of attorney if the filing is effected by a representative.

All the documents mentioned under 1 and 2 should be filed in duplicate, except in case of filing a reproduction of the model, where it will suffice that it shall be accompanied by a picture of the latter. They must all bear the designation given to the model (see 1, *b*), the name and residence of the applicant, and the date of filing.

All the written documents must be drawn up on sheets of paper thirty-three by twenty-one centimeters.

MODELS.

The Patent Office may require the filing of models of the objects to be patented whenever it is considered necessary.

When it is a question of applications for patents relating to processes for the manufacture of chemical products, there must be filed a sample of the products in question, as well as the intermediate products necessary for the application of these processes. If the invention relates to colors derived from tar, there must likewise be filed samples of wool, silk, or cotton dyed in these colors.

THE GRANT.

First.—Preliminary examination relating to the formalities of the application and the patentability and novelty of the invention.

Second.—Publication of the application, with call for opposition. Time allowed for opposition, two months. In case of rejection of application, or in case of allowance of a contested application the interested party may appeal, within a term of one month, to the Patent Office, Division of Appeals.

Models of Utility, (*Gebrauchsmuster.*)

Registry is accorded without examination on compliance with the legal formalities. Patentee may be compelled to grant licenses to others.

WORKING.

Patented invention must be worked within three years after publication of grant of patent.

Great Britain.

(MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The patent is valid only when granted to the true and first inventor either alone or jointly with another or others.

A person resident in the United Kingdom to whom an invention has been communicated from abroad is considered a first and true inventor.

In case of decease of the inventor the patent is granted to his legal representative.

PATENTABLE INVENTIONS.

Any manner of new manufactures, provided they are not in use or publicly known at the time of the grant of the patent and are not contrary to the law nor mischievous to the State by raising the price of commodities in the United Kingdom or injuring trade or generally inconvenient. (Statute of 1623.)

NATURE AND DURATION OF THE PATENT—TAXES.

Only one kind of patent is issued, having duration of fourteen years from the date of filing the application.

Taxes: At the filing of the application for provisional protection, 1 pound; at the subsequent filing of the complete specification, 3 pounds; at the filing of the complete specification with the first application, 4 pounds (the payment of these filing fees assures the legal protection during the first four years of the patent); fifth year, 5 pounds; sixth year, 6 pounds, and so on, increasing by 1 pound a year.

Pound=$4.866½.

APPLICATION—FORMALITIES AND DOCUMENTS.

The application, addressed to the Patent Office, must declare that the applicant is in possession of an invention of which he is the true and first inventor. It must be accompanied by a specification, either provisional or complete.

The provisional specification must describe the nature of the invention.

The complete specification must describe and explain in detail the nature of the invention and the manner in which it must be carried out and be accompanied by drawings, if necessary.

The specification (provisional or complete) must begin with the title. The complete specification must end with a precise indication of the invention claimed.

If the application is accompanied by a provisional specification, the applicant may file the complete specification within the nine months following.

If agents represent applicants, they must be duly appointed by the applicant.

Every application that is to enjoy the time allowance of priority established by Article 4 of the International Convention or a similar arrangement of a convention concluded between Great Britain and a foreign State, must contain a declaration

proving the filing of the anterior application made abroad and specify the foreign States in which applications have been made for patents for the same invention, as well as the official dates of these applications. The application must be made by the person who made the foreign application within seven months following the first foreign application.

There must also be furnished a certified copy of the specification filed by the applicant in the Patent Office of the foreign State, together with a statutory declaration affirming the identity of the invention with the invention in reference to which the first foreign application was made. If the foreign specification be in a foreign language a translation must be annexed and certified to in conformity with the original.

The applications and specifications mentioned above must be drawn up on blanks that may be procured at the principal post offices of the United Kingdom.

MODELS.

The Department of Science and Arts may at any time require the patentee to furnish a model of his invention on payment of the expenses of the manufacture of the model.

THE GRANT.

First.—Examination of the complete specification to see that it has been prepared in the manner prescribed, and if the invention described in detail is the same as that described in the provisional specification.

Second.—Publication of the acceptance of the complete specification, when the application is open for two months to the public for opposition by interested parties.

The patent is issued if unopposed or in event of an unsuccessful opposition.

WORKING.

Any interested party can oblige the inventor to grant him a license on such terms as the Board of Trade may determine.

Italy.

(MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The right to the patent is accorded to the author of a new industrial invention or discovery or his assignee.

PATENTABLE INVENTIONS.

Any new industrial invention.

An invention is called "industrial" when it has directly for its object, first, an industrial product or result; second, an instrument, a machine, a tool, a mechanism, or any mechanical

construction whatsoever; third, a process or method of industrial production; fourth, a motor or the industrial application of a force already known; fifth, the technical application of a scientific principle, provided it gives immediate industrial results.

An invention is not considered new when it has been previously known in Italy, or has been published in Italy or elsewhere.

Description in a printed publication due to requirement of foreign patent law does not invalidate a patent of importation.

INVENTIONS EXCLUDED FROM PROTECTION.

First.—Inventions relating to industries contrary to law, to morality, and to public safety.

Second.—Inventions which have not for their aim the production of material objects.

Third.—Inventions or discoveries purely theoretical.

Fourth.—Medicines.

NATURE AND DURATION OF THE PATENT—TAXES,

Three kinds of patents:

First.—Patents of invention. Duration, one to fifteen years, as elected by the applicant, reckoning from the last day of March, June, September or December next following the date of application. Patents granted for a less term than fifteen years may be prolonged to the full term.

Second.—"Patents of importation," for new inventions already patented abroad. The same duration as the foreign patent conceded for the longest term, without, however, exceeding the term of fifteen years.

Third.—"Patents of improvement."

Fourth.—"Patents of addition." The same duration as the principal patent to which they refer.

Taxes: First, Patents of invention and importation, 40 lire for the first three years, besides 10 lire per year indicated in the application for the patent; 65 lire for each of the years four to six; 90 lire for each of the years seven to nine; 115 lire for each of the years ten to twelve; 140 lire for each of the last three years; second, "patents of addition," single tax of 20 lire. There is also a "prolongation tax" of 40 lire, payable in addition to the annuities and proportional tax when it is desired to prolong the term of a patent originally taken for less than fifteen years.

Lira=$0.193.

APPLICATION—FORMALITIES AND DOCUMENTS.

The application for a patent must be addressed to the Minister of Agriculture, Industry and Commerce through the local prefecture or sub-prefecture. It must contain—

First, the surname and Christian name, the country, and the residence of the applicant and of his representative, if the case calls for it;

Second, the title of the invention;

Third, a statement of the duration desired for the patent.

To the application must be joined—

First, the description of the invention;

Second, the drawings, when possible, and the models which may be considered necessary for the understanding of the invention;

Third, the receipt for the payment of the prescribed taxes and stamp fees;

Fourth, the original title or certified copy of the patent granted to the foreigner, when a patent of importation.

Fifth, if the application is filed by a representative, the power of attorney in authentic form, or in unauthenticated form with the signature of the applicant certified to by a notary or by the magistrate (syndic) of the commune where the said applicant resides;

Sixth, a list of the documents and articles filed.

The description must be written in Italian or French, and must contain a complete and detailed statement of all the particulars necessary to enable one skilled in the art to put the invention into practice.

Three copies of the description and the drawings, signed by the applicant, must be filed.

If a model is filed, it will be sufficient to file two copies of the drawings.

The application and the three copies of the description must be written on paper stamped with 50 centimes. The description must be headed "Description of the invention having for title," etc.

The drawings must be furnished in triplicate, one being on bristol-board, in good black ink, for photographic reproduction, and two copies on tracing-cloth. There are no fixed dimensions for the sheet. It is only essential that the figures shall not exceed forty centimeters in any direction. Each sheet must have a fifty-centime stamp.

MODELS.

Models need be filed only when the inventor considers it necessary for the understanding of the invention. In this case each model must be furnished with a tag of carboard or wood, on which shall be placed the signature of the party receiving the deposit and that of the one making it.

THE GRANT.

The patent is granted without preliminary examination as to the novelty of the invention.

The administration refuses the patent only if the application bears upon an invention in a class declared not patentable by law, or if the filing has not been regularly effected. In case of refusal the applicant may within fifteen days address a complaint to a special commission named each year by the Minister.

Patents relating to beverages or foods are not granted except upon the favorable judgment of the Superior Council of Health.

WORKING.

If the patent is granted for five years or less, the invention must be worked in Italy within one year from the date of the patent, and working must not be omitted for more than one year. If the patent is granted for more than five years, the invention must be worked within two years, and working must not be omitted for more than two years.

Japan.

(NOT A MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The inventor only may apply for a patent. In case a person who has applied for or obtained a patent dies his rights devolve on his heirs or assigns.

In case of interfering applications the patent is granted to the prior inventor. When in case of interference between an application and a patent priority is awarded to the applicant and the existing patent is revoked, the patent granted to the applicant dates from the date of the revoked patent and has the same term.

Applicants residing abroad must appoint a representative residing in Japan.

PATENTABLE INVENTIONS.

Any new and useful technical process, machine, manufacture, or compound, or any new and useful improvement thereof.

Inventions publicly known or publicly used before application for patent is made are not considered new.

Inventions from which no good result can be expected are not considered patentable.

When the general use of an invention is considered desirable for the public interest, or it is considered desirable that the invention be kept secret for military purposes, the Minister of

State for Agriculture and Commerce may grant a conditional patent, or refuse to grant a patent, or may fix conditions to or cancel a patent already granted. In such case he must give the inventor or owner of the patent adequate compensation.

An improvement on a patented invention can be patented only after a license to use the original invention with the improvement has been obtained from the owner of the patent either by agreement, or in certain cases, by direction of the Minister of State for Agricultnre and Commerce on payment of adequate compensation.

INVENTIONS EXCLUDED FROM PROTECTION.

First.—Articles of food, drink, or fashion.

Second.—Medicines or methods of compounding them.

Third.—Articles which have been in public use before the application for a patent. This does not exclude articles which have been on public trial not more than two years.

NATURE AND DURATION OF THE PATENT—TAXES.

Patents are granted for terms of five, ten, or fifteen years, as the applicant may elect. Term is reckoned from day of registration.

A patent which is lost or damaged may be reissued on payment of a fee of 1 yen.

A patent of which the drawing or specification is insufficient may be amended, provided the essential features of the invention are not changed.

Fees: For application of patent, 5 yen; for the grant of Letters Patent for five years, 20 yen; for ten years, 30 yen; for fifteen years, 40 yen. For amended Letters Patent: For a patent for five years, 10 yen; for ten years, 15 yen; for fifteen years, 20 yen.

Yen=$1.00.

APPLICATION—FORMALITIES AND DOCUMENTS.

Application addressed to the Minister of State for Agriculture and Commerce stating the name, status, occupation, domicile, and present residence of the applicant, the title of the invention, the date at which the invention was made, and the term for which a patent is desired, signed and sealed by the applicant, together with the specification and necessary drawings, must be filed at the Patent Bureau. Registration stamps of a value corresponding to the required fee must be affixed.

A foreigner making application for patent must furnish a certificate of nationality. All documents must be written in Japanese. A power of attorney, certificate of nationality, or other document written in a foreign language must be accompanied by a translation.

The specification must be clearly written without erasure or alteration on Mino paper, thirteen lines per page and twenty-five characters per line. It must comprise—

First, title sufficiently indicating the nature of the invention;

Second, brief statement of the nature and purpose of the invention;

Third, brief explanation of the drawings, if any;

Fourth, detailed explanation of the invention, referring to the drawings, if any, sufficiently clear to enable any person of ordinary ability to work the invention without difficulty, the meaning of words used in the claims being explained;

Fifth, in case of an improvement the difference between the original invention and the improvement must be pointed out;

Sixth, claims in which the essential features of the invention shall be pointed out.

Drawings must be in black india-ink and must be suitable for reproduction by photolithography. Space occupied by figures, 7.2 by 4.6 suns. (Sun=1.19 inch.) Margin at top, .1 sun; at bottom, .8 sun; at left, .3 sun; at right, 1.5 sun. On the drawing shall be put only the name of the applicant and his agent, with the seal of the latter. Not more than one sheet shall be used unless necessary. As little shading shall be used as possible. Section shall be shown by parallel lines about .3 sun apart. Four copies of drawings are required, which must be on Mino paper.

MODELS.

Models or specimens, when required, must be filed within ninety days from the date of notice that they are required.

THE GRANT.

Preliminary examination as to formalities and as to novelty and patentability. In case of rejection re-examination may be demanded. Any person dissatisfied with the re-examination may appeal to the Director of the Patent Bureau, who hears the case with two or more assistants. Costs in appeals are assessed as in civil suits.

WORKING.

Patented inventions must be worked within three years from the date of the patent, and working must not be discontinued for more than three years.

Mexico.

(NOT A MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The patent is granted to the inventor only, or, if already patented abroad, to the applicant for the foreign patent or his

assignee. Persons not residing in Mexico must appoint a resident representative. Patentee has the exclusive right for one year after the grant to patent improvements.

PATENTABLE INVENTIONS.

A patent may be obtained on a new industrial product, a new method of production, or a new application of means already known to obtaining a result or an article useful in industry. Chemical or pharmaceutical preparations are likewise patentable. Inventions are not new if given such publicity in Mexico or abroad as to enable them to be worked; but this does not include publication by foreign patent office.

INVENTIONS EXCLUDED FROM PROTECTION.

First.—Inventions of which the operation is forbidden by law or imperils the lives and property of citizens.

Second.—Scientific principles or discoveries of a purely speculative order and not taking any tangible shape.

NATURE AND DURATION OF THE PATENT—TAXES.

Patents are granted for twenty years, dating from the date of the grant. The term may be extended for five years at the discretion of the executive. Patents granted for inventions previously patented abroad expire at the same time with the foreign patent, or, if more than one, with the foreign patent first granted.

The taxes are, before the expiration of the fifth year, $50 (Mexican); before the expiration of the tenth year, $75; before the expiration of the fifteenth year, $100.

APPLICATION—FORMALITIES AND DOCUMENTS.

Application in due form must be made to the Department of Public Works, and must include petition, duplicate specification (in Spanish), and duplicate drawings on cloth or paper of any convenient size, with margin at the sides.

A non-resident who is unable to appear personally must appoint a resident agent by notarial power, legalized by Mexican counsel.

MODELS.

Models are not usually required.

THE GRANT.

Patents are granted without preliminary examination; but notice of application must be published three times in the *Official Journal*, with call for opposition. Time allowed for opposition, two months.

WORKING.

Patented inventions must be worked within five years from the date of the patent.

Russia.

(NOT A MEMBER OF THE INTERNATIONAL UNION.)

WHO MAY OBTAIN A PATENT.

The right to the patent belongs to the inventor or to his assignee. The patent is granted to the first applicant.

If the petitioner be living abroad, he must appoint a representative living in Russia.

PATENTABLE INVENTIONS.

Inventions which present an element essentially new, either in whole or in one or several of their parts or in the original combination of their parts when they are already known separately.

INVENTIONS EXCLUDED FROM PROTECTION.

The inventions, first, which represent scientific discoveries and abstract theories; second, which are contrary to public order, to morality, and to good manners; third, which previous to the application for the patent have been patented in Russia, or have been used there without a patent, or which have been described in print in a manner sufficiently complete to be reproduced; fourth, which are known abroad without a patent or which are there patented in the name of the person other than the petitioner, except in case the invention shall have been assigned to the latter; fifth, which do not represent a sufficient novelty, but constitute trifling modifications of inventions already known.

Patents are not granted for chemical products, foods, and the like, for compounded medicines, though for the processes and apparatus designed for the manufacture of the latter, patents may be obtained. In addition, patents are not at present granted for munitions of war unless adapted to other purposes, in which case the grant is subject to the right of the Government to use the same without compensation.

NATURE AND DURATION OF THE PATENT—TAXES.

Two kinds of patents:

First.—Patents of invention. Duration, fifteen years, to start from the date of the signing of the patent.

Second.—"Patents of addition." Expire with the principal patent to which they refer.

Taxes: First, patents of invention, fee for filing, 30 rubles; first year, 15 rubles; second year, 20 rubles; third year, 25

rubles; fourth year, 30 rubles; fifth year, 40 rubles; sixth year, 50 rubles; seventh year, 75 rubles; eighth year, 100 rubles; ninth year, 125 rubles; tenth year, 150 rubles; eleventh year, 200 rubles; twelfth year, 250 rubles; thirteenth year, 300 rubles; fourteenth year, 350 rubles; fifteenth year, 400 rubles; second, "patents of addition," single tax, 30 rubles.

A patent granted for an invention already patented abroad previous to the date of the filing of the application expires as soon as the patent or one of the foreign patents of anterior date has ceased to exist.

Ruble=$0.772.

APPLICATION—FORMALITIES AND DOCUMENTS.

First.—Application for a patent addressed to the Department of Trade and Manufactures, with the heading "To the Committee on Technical Affairs." It must be written upon a sheet of paper of ordinary size, furnished with two stamps of 80 copecks and containing a request for the granting of a patent for the invention indicated in the description and the title of the invention, corresponding to the nature of the latter.

Second.—A memorandum of the documents inclosed, the principal of which are the description, the explanatory drawings, the receipt for the fee for filing of 30 rubles, and, the case requiring it, the power of attorney in favor of the representative.

The application must be signed by the petitioner or by his representative, signing by power of attorney, which in the case of a foreign applicant must be legalized.

The description must be written in the Russian language and be clear and plain. It must be accompanied, if the case requires, by drawings and models sufficiently plain to enable one to reproduce the invention. At the end it must contain an enumeration of the distinctive particulars of the invention. The description must be written on paper of ordinary size, in duplicate, and signed by the petitioner or his representative. A stamp of 80 copecks must be affixed to each sheet of one of the copies.

The drawings must be in black lines, on thick white drawing paper. Their size must be thirteen inches long by eight inches in width, or thirteen inches by sixteen, or thirteen inches by twenty-four. Each drawing must be surrounded by a margin of about one inch. Upon the upper margin must be indi-

cated the application to which the drawing relates. The addition of explanatory words and the use of colors are prohibited.

The drawings must be filed in duplicate, one of which must be on drawing-paper and one on tracing-cloth. The usual designation of the figures—*i. e.*, "Fig."—must not appear on the drawing.

The applications presented by the representative must be accompanied by a power of attorney. If the petitioner is living abroad, and if the power of attorney is written in a foreign language, this power of attorney must bear the signature of the local Russian consul, certifying that it is executed according to the laws of the country, and be accompanied by a certified translation in the Russian language.

If the invention be already patented abroad, the application must be accompanied by a certified copy of that foreign patent which is the first to expire.

If the patent is asked for an invention patented abroad in the name of another person, the petitioner must file a certified assignment stating that he has received the exclusive right to use the invention in Russia.

MODELS.

The filing of models is required if it be necessary in order to easily reproduce the invention.

THE GRANT.

The applicant for a patent who has complied with the prescribed formalities receives a certificate of protection, which permits him to use his invention, to make it known, and to threaten infringers with prosecution. This certificate ceases to be in force if a patent is denied.

The application is submitted to the Committee of Technical Affairs of the Department of Commerce and Manufactures, which determines whether the application and the description of the invention answer to the conditions established by law. These researches do not bear either upon the utility of the invention or upon the existence of the right of the petitioner.

In case of refusal the interested party may appeal within the three months to the Department of Commerce and Manufactures.

WORKING.

Patented invention must be worked in Russia within five years from the grant of the patent.

U. S. MINING LAWS.

Valuable Information for Owners and Locators of Mines.

WHERE papers have once been filed with the Register and Receiver, they become a part of the record, and can neither be withdrawn nor returned, but must be transmitted to the General Land Office.

An application will be rejected when the description of the premises is erroneous or insufficient.

Application for patent will be rejected because:

1. The notice was published without the knowledge ot the Register.
2. The notice was not published in a newspaper designated as published nearest the claim.
3. Record title was found defective ; and,
4. A previous application had been made for the same premises, which was withdrawn pending a suit in court commenced by the adverse claimant.

An application for patent will be rejected when the survey does not accurately define the boundaries of the claim.

Where the claim was not located in accordance with law.

Where several parties own separate and distinct portions of a claim, application for patent may be made by either for that portion of the claim owned by him ; but where several parties own undivided interests in a mining claim, all should join in an application for a patent.

A person or association may purchase as many placer locations as the local law admits, and embrace them all in one application for a patent.

Two or more lodes cannot be embraced in one application for a patent except for placer claims embracing two or more lodes within their boundaries.

Paper sworn to before any person purporting to act as a deputy for the Register and Receiver, cannot be recorded as evidence.

In all patents for mining claims situated within the interior boundaries of a town site, a clause is inserted "excepting and excluding all town property, rights upon the surface, and all houses, buildings, structures, lots, blocks, streets, alleys, or other municipal improvements not belonging to the grantee herein, and all rights necessary or proper to the occupation, possession and enjoyment of the same."

Publication of notice must be made in only one newspaper for the period of sixty days.

Notice must be published ten consecutive weeks in weekly newspapers, and in daily newspapers sixty days must elapse between the first and last insertion.

Where the Register designates the daily issue of a newspaper for publication of notices of a mining application for patent, it is not a compliance with law to change to the weekly edition of the same paper, without authority of the Register.

The existence of a salt spring on a tract of land withdraws it from the operation of the homestead and pre-emption laws. A hearing for the purpose of proving the agricultural character of such lands is not allowed. Land containing valuable deposits of slate may be entered under the mining acts.

Adverse Claims.

Adverse claimants must file a separate and distinct claim against each application which it is alleged conflicts with the premises owned by such adverse claimant.

The papers in an adverse claim once filed cannot be withdrawn, but become part of the record.

When an adverse claim has been filed it cannot be amended so as to embrace a larger portion of the premises than that described in the original adverse claim.

An adverse claim must be made out in proper form and filed in the proper local office during the period of publication of the application for the patent to be effective.

It is the duty of the adverse claimant to commence suit in proper form within the required time, and if he trusts the uncertain medium of the United States mail, he must abide the consequences, should the delay ensue through misfortune or accident. Should the failure to commence suit be the result of the corrupt or dishonest action of his attorney, the Interior Department cannot redress the wrong.

An adverse claimant should set forth in detail the facts upon which he bases his adverse claim. A statement in general terms, embodying conclusions of law, without stating the facts generally, will not be considered in evidence.

An adverse claimant should show a compliance with the local laws in recording his claim and in regard to expenditures, and shall file a copy of the original notice of his location, and show the nature or extent of the conflict alleged.

An allegation of parties to a suit that they compose the company is sufficient, and they are not required to prove that they are the original locators or the identical parties who presented the adverse claim.

Agricultural or Mineral Lands.

Where land is of little if any value for agricultural purposes, but is essential to the proper development of mining claims, it should be disposed of under the Mining Act.

Where lands containing valuable mineral deposits have been included in an agricultural entry, said entry will be canceled at any time prior to issuance of patent, upon satisfactory evidence of the existence of such valuable deposits.

Where valuable deposits of mineral are discovered upon a tract after the same has been entered as agricultural, but before patent has been issued, the parties claiming the mine might make application for patent for same, and the agricultural entry will be canceled to that portion of the land embraced by said mining claim.

Where mineral deposits are discovered on agricultural lands after patent has been issued to an agricultural claimant, they pass with the patent.

Agricultural college scrip cannot be received in payment for claims.

Aliens.

A foreigner may make a mining location and dispose of it, provided he becomes a citizen before disposing of the mine. Proof that the party was not a citizen before disposing of his claim must be affirmatively shown.

Locators and intermediate owners other than applicants will not be presumed aliens in the absence of allegation or objection prior to issuance of patent.

The portion of a mining claim sold to an alien cannot be patented while such owner is an alien; but on his declaration to become a citizen his right dates back to his purchase, and he may thereupon secure a United States patent for his claim.

Tunnels.

There is no authority of law for a tunnel location 3,000 by 1,500 feet. A proper location is the width of the tunnel for 3,000 feet.

There is no provision of law for patenting tunnel locations, but lodes discovered in running a tunnel may be patented in like manner as other lodes.

When a lode is struck or discovered for the first time in running a tunnel, the tunnel owners have the option of recording their claim of 1,500 feet all on one side of the point of discovery or intersection, or partly on one side thereof and partly on the other.

Prospecting for blind lodes is prohibited on the line of a located tunnel, while the tunnel is in progress, but other parties are in no way debarred from prospecting for blind lodes or running tunnels, so long as they keep without the line of such tunnel.

The right is granted to tunnel owners to 1,500 feet of each blind lode not previously known to exist, which may be discovered in their tunnel.

Cross Ledges.

Revised Statutes. Section 2336. Where two or more ledges cross or intersect each other, priority of title shall govern, and such prior location shall be entitled to all ore or mineral contained within the space of intersection, but the subsequent

location shall have the right of way through the space of intersection for the purpose of the convenient working of the mine. And where two or more veins unite, the oldest or prior location shall take the vein below the point of union, including all the space of the intersection.

THE LAW OF COPYRIGHT.

1. A *printed* copy of the title (besides the two copies to be deposited after publication) of the book, map, chart, dramatic or musical composition, engraving, cut, print or photograph, or a *description* of the painting, drawing, chromo, statue, statuary or model or design for a work of the fine arts, for which copyright is desired, must be sent by mail or otherwise, *prepaid*, addressed "Librarian of Congress, Washington, D. C." This must be done before the publication of the book or other article. The applicant must state distinctly the name and residence of the claimant, and whether copyright is claimed as author, designer or proprietor. The *printed title* required may be a copy of the title page of such publications as have title pages. In other cases, the title must be printed expressly for copyright entry, with name of claimant of copyright. The style of type is immaterial, and the print of a typewriter will be accepted. But a separate title is required for each entry, and *each* title must be printed on paper as large as commercial note. The title of a *periodical* must include the date and number.

2. The legal fee for *recording* each copyright claim is 50 cents, and for a *copy* of this record (or certificate of copyright) an additional fee of 50 cents is required. Certificates covering more than one entry are not issued.

3. Within ten days after publication of each book or other article, two complete copies of the best edition issued must be sent, to perfect the copyright, with the address "Librarian of Congress, Washington, D. C." The postage must be prepaid, or else the publication inclosed in parcels covered by printed Penalty Labels, furnished by the Librarian, in which case they will come FREE by mail, without limit of weight. Without the deposit of copies above required the copyright is void, and a penalty of $25 is incurred.

4. No copyright is valid unless notice is given by inserting in every copy published, on the title page or the page following, if it be a book; or, if a map, chart, musical composition, print, cut, engraving, photograph, painting, drawing, chromo, statue, statuary or model design intended to be perfected as a work of the fine arts, by inscribing upon some portion thereof, or on the substance on which the same is mounted, the following words, viz: *"Entered according to act of Congress, in the year——, by———, in the office of the Librarian of Congress, at Washington,"* or, at the option of the person entering the copyright, the words: *"Copyright, 18—, by———."*

The law imposes a penalty of $100 upon any person who has not obtained a copyright who shall insert the notice *"Entered according to act of Congress,"* or *"Copyright,"* etc., or words of the same import, in or upon any book or other article.

5. Any author may reserve the right to translate or dramatize his own work. In this case, notice should be given by printing the words *"Right of translation reserved,"* or *"All rights reserved,"* below the notice of copyright entry, and notifying the Librarian of Congress of such reservation, to be entered upon the record.

6. The original term of copyright runs for twenty-eight years. *Within six months before* the end of that time, the author or designer, or his widow or children, may secure a renewal for the further term of fourteen years, making forty-two years in all.

7. The time within which any work entered for copyright may be issued from the press is not limited by any law or regulation, but depends upon the discretion of the proprietor. A copyright may be secured for a projected work as well as for a completed one. But the law provides for no *caveat*, or notice of interference—only for actual entry of title.

8. A copyright is assignable in law by any instrument of writing, but such assignment must be recorded in the office of the Librarian of Congress within sixty

days from its date. The fee for this record and certificate is $1, and for a certified copy of any record of assignment $1.

9. A copy of the record (or duplicate certificate) of any copyright entry will be furnished, under seal, at the rate of 50 cents each.

10. In the case of books published in more than one volume, or of periodicals published in numbers, or of engravings, photographs or other articles published with variations, a copyright is to be entered for each volume or part of a book, or number of a periodical, or variety, as to style, title or inscription, of any other article. But a book published serially in a periodical, under the same general title, requires only one entry. To *complete* the copyright on such a work, two copies of each serial part, as well as of the complete work (if published separately), must be deposited.

11. To secure a copyright for a painting, statue, or model or design intended to be perfected as a work of the fine arts, so as to prevent infringement by copying, engraving, or vending such design, a definite description must accompany the application for copyright, and a photograph of the same, at least as large as "cabinet size," should be mailed to the Librarian of Congress within ten days from the completion of the work or design.

12. Copyrights cannot be granted upon trademarks, nor upon mere names of companies or articles, nor upon prints or labels intended to be used with any article of manufacture. If protection for such names or labels is desired, application must be made to the Patent Office.

13. Citizens or residents of the United States only are entitled to copyright.

THE LAW OF TRADEMARKS.

Any person, firm or corporation can obtain protection for any lawful trademark by complying with the following:

1. By causing to be recorded in the Patent office the name, residence and place of business of persons desiring the trademark.
2. The class of merchandise and description of the same.
3. A description of the trademark itself with fac-similes.
4. The length of time that the said mark has already been used.
5. By payment of the required fee—$6.00 for labels and $25 for trademarks.
6. By complying with such regulations as may be prescribed by the commissioner of patents.
7. A lawful trademark must consist of some arbitrary word (not the name of a person or place), indicating or not the use or nature of the thing to which it is applied; of some designation symbol, or of both said word and symbol.

HOW TO OBTAIN A PATENT.

Patents are issued in the name of the United States, and under the seal of the Patent Office, to any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof, not known or used by others in this country, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned; and by any person who, by his own industry, genius, efforts and expense has invented and produced any new and original design for a manufacture, bust, statue, alto-relievo, or bas-relief; any

new and original design for the printing of woolen, silk, cotton or other fabrics ; any new and original impression. ornament, pattern, print or picture to be printed, painted, cast or otherwise placed on or worked into any article of manufacture ; or any new, useful and original shape or configuration of any article of manufacture, the same not having been known or used by others before his invention or production thereof, or patented or described in any printed publication, upon payment of the fees required by law and other due proceedings had.

Every patent contains a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use and vend the invention or discovery throughout the United States and the Territories, referring to the specification for the particulars thereof.

If it appear that the inventor, at the time of making his application, believed himself to be the first inventor or discoverer, a patent will not be refused on account of the invention or discovery, or any part thereof, having been known or used in any foreign country before his invention or discovery thereof, if it had not been before patented or described in any printed publication.

Joint inventors are entitled to a joint patent; neither can claim one separately. Independent inventors of distinct and independent improvements in the same machine cannot obtain a joint patent for their separate inventions; nor does the fact that one furnishes the capital and another makes the invention entitle them to make application as joint inventors; but in such case they may become joint patentees.

The receipt of letters patent from a foreign government will not prevent the inventor from obtaining a patent in the United States, unless the invention shall have been introduced into public use in the United States more than two years prior to the application. But every patent granted for an invention which has been previously patented by the same inventor in a foreign country will be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest unexpired term, but in no case will it be in force more than seventeen years.

Applications.

Application for a patent must be made in writing to the Commissioner of Patents. The applicant must also file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding and using it, in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound and use the same ; and in case of a machine, he must explain the principle thereof, and the best mode in which he has contemplated applying that principle, so as to distinguish it from other inventions, and particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery. The specification and claim must be signed by the inventor and attested by two witnesses.

When the nature of the case admits of drawings, the applicant must furnish one copy signed by the inventor or his attorney in fact, and attested by two witnesses, to be filed in the Patent Office. In all cases which admit of representation by model, the applicant, if required by the Commissioner, shall furnish a model of convenient size to exhibit advantageously the several parts of his invention or discovery.

The applicant shall make oath that he verily believes himself to be the original and first inventor or discoverer of the art, machine, manufacture, composition or improvement for which he solicits a patent ; that he does not know and does not believe that the same was ever before known or used, and shall state of what country he is a citizen. Such oath may be made before any person within the United States authorized by law to administer oaths, or, when the applicant resides in a foreign country, before any minister, charge d'affaires, consul or commercial agent,

holding commission under the Government of the United States, or before any notary public of the foreign country in which the applicant may be.

On the filing of such application and the payment of the fees required by law, if, on such examination, it appears that the claimant is justly entitled to a patent under the law, and that the same is sufficiently useful and important, the Commissioner will issue a patent therefor.

Assignments.

Every patent or any interest therein shall be assignable in law by an instrument in writing; and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under his patent to the whole or any specified part of the United States.

Reissues.

A reissue is granted to the original patentee, his legal representatives, or the assignees of the entire interest when, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his invention or discovery more than he had a right to claim as new, the original patent is inoperative or invalid, provided the error has arisen from inadvertance, accident or mistake, and without any fraudulent or deceptive intention. In the cases of patents issued and assigned prior to July 8, 1870, the applications for reissue may be made by the assignees; but in the cases of patents issued or assigned since that date, the applications must be made and the specifications sworn to by the inventors, if they be living.

Caveats.

A caveat, under the patent law, is a notice given to the office of the caveator's claim as inventor, in order to prevent the grant of a patent to another for the same alleged invention upon an application filed during the life of the caveat without notice to the caveator.

Any citizen of the United States who has made a new invention or discovery, and desires further time to mature the same, may, on payment of a fee of $10, file in the Patent Office a caveat setting forth the object and the distinguishing characteristics of the invention, and praying protection of his right until he shall have matured his invention. Such caveat shall be filed in the confidential archives of the office and preserved in secrecy, and shall be operative for the term of one year from the filing thereof.

An alien has the same privilege, if he has resided in the United States one year next preceding the filing of his caveat, and has made oath of his intention to become a citizen.

The caveat must comprise a specification, oath, and, when the nature of the case admits of it, a drawing, and, like the application, must be limited to a single invention or improvement.

Fees.

Fees must be paid in advance, and are as follows: On filing each original application for a patent, $15. On issuing each original patent, $20. In design cases: For three years and six months, $10; for seven years, $15; for fourteen years, $30. On filing each caveat, $10. On every application for the reissue of a patent, $30. On filing each disclaimer, $10. For certified copies of patents and other papers, including certified printed copies, 10 cents per hundred words. For recording every assignment, agreement, power of attorney or other paper, of three hundred words or under, $1; of over three hundred and under one thousand words, $2; of over one thousand words, $3. For copies of drawings, the reasonable cost of making them.

Greatest Known Depth of the Ocean.

The greatest known depth of the ocean is midway between the islands of Tristan d'Acunha and the mouth of the Rio de la Plata. The bottom was here reached at a depth of 46,236 feet, or eight and three-fourths miles, exceeding by more than 13,000 feet the height of Mt. Hercules, the loftiest mountain in the world. The average depth of all the oceans is from 2,000 to 3,000 fathoms.

INSURANCE.

A *STOCK Insurance Company* is one whose capital is owned by stockholders, they alone sharing the profits and they alone being liable for losses. The business of such a company, and also of a mixed company, is managed by directors chosen by the stockholders. Policy-holders, unless at the same time stockholders, have no voice in the management of the company's business or in the election of its officers.

A Mutual Insurance Company is one in which the profits and losses are shared among the policy-holders (the insured.)

Mixed Companies are a combination of the foregoing. In a mixed company all profits above a certain fixed dividend are usually divided among the policy-holders.

Some mutual an ' mixed companies issue what are called ***non-participating policies.*** The holders of these do not share in the profits or losses.

FIRE INSURANCE.

Policies for fire insurance are generally issued for a period of one to five years. Ordinarily, in case of loss by fire, the insured will be paid the extent of his loss up to the amount of insurance, unless the insurance company prefer to replace or repair the damaged property, which privilege is usually reserved. If the policy contains the "average clause" the payment will cover only such portion of the loss as the amount of insurance bears to the value of the property insured.

A Floating Policy is one which covers property stored in several buildings or places. The name is applied more particularly to policies which cover goods whose location may be changed in process of manufacture, or in the ordinary course of business. The "average clause" is a usual condition of policies of this class.

Short Rates are rates for a term less than a year. If an insurance policy is terminated at the request of the policy-holder, the company retains the customary "short rates" for the time the policy has been in force, as shown by the following tables:

Policy for 1 year.	Policy for 2 years.	Policy for 3 years.	Policy for 4 years.	Policy for 5 years.	Charge this proportion of whole Premium.
1 mo.	2 mo.	3 mo.	4 mo.	5 mo.	20 per cent.
2 "	4 "	6 "	8 "	10 "	30 "
3 "	6 "	9 "	12 "	15 "	40 "
4 "	8 "	12 "	16 "	20 "	50 "
5 "	10 "	15 "	20 "	25 "	60 "
6 "	12 "	18 "	24 "	30 "	70 "
7 "	14 "	21 "	28 "	35 "	75 "
8 "	16 "	24 "	32 "	40 "	80 "
9 "	18 "	27 "	36 "	45 "	85 "
10 "	20 "	30 "	40 "	50 "	90 "
11 "	22 "	33 "	44 "	55 "	95 "

WEIGHTS AND MEASURES.

Troy Weight—24 grains make 1 pennyweight, 20 pennyweights make 1 ounce. By this weight, gold, silver and jewels only are weighed. The ounce and pound in this are same as in Apothecaries' weight.

Apothecaries' Weight—20 grains make one scruple, 3 scruples make 1 dram, 8 drams make 1 ounce, 12 ounces make 1 pound.

Avoirdupois Weight—6 drams make 1 ounce, 16 ounces make one pound, 25 pounds make 1 quarter, 4 quarters make 1 hundredweight, 2,000 pounds make 1 ton.

Dry Measure—2 pints make 1 quart, 8 quarts make 1 peck, 4 pecks make 1 bushel, 36 bushels make 1 chaldron.

Liquid or Wine Measure—4 gills make 1 pint, 2 pints make 1 quart, 4 quarts make 1 gallon, 31½ gallons make 1 barrel, 2 barrels make 1 hogshead.

Time Measure—60 seconds make 1 minute, 60 minutes make 1 hour, 24 hours make 1 day, 7 days make 1 week, 4 weeks make 1 lunar month, 28, 29, 30 or 31 days make 1 calendar month (30 days make 1 month in computing interest), 52 weeks and 1 day, or 12 calendar months, make 1 year; 365 days, 5 hours, 48 minutes and 49 seconds make 1 solar year.

Circular Measure—60 seconds make 1 minute, 60 minutes make 1 degree, 30 degrees make 1 sign, 90 degrees make 1 quadrant, 4 quadrants or 360 degrees make 1 circle.

Long Measure—Distance—3 barleycorns 1 inch, 12 inches 1 foot, 3 feet 1 yard, 5½ yards 1 rod, 40 rods 1 furlong, 8 furlongs 1 mile.

Cloth Measure—2¼ inches 1 nail, 4 nails 1 quarter, 4 quarters 1 yard.

Miscellaneous—3 inches one palm, 4 inches 1 hand, 6 inches 1 span, 18 inches 1 cubit, 21.8 inches 1 Bible cubit, 2½ feet 1 military pace.

Square Measure—144 square inches 1 square foot, 9 square feet 1 square yard, 30¼ square yards 1 square rod, 40 square rods 1 rood, 4 roods 1 acre.

Surveyors' Measure—7.92 inches 1 link, 25 links 1 rod, 4 rods 1 chain, 10 square chains or 160 square rods 1 acre, 640 acres 1 square mile.

Cubic Measure—1,728 cubic inches 1 cubic foot, 27 cubic feet 1 cubic yard, 128 cubic feet 1 cord (wood), 40 cubic feet 1 ton (shipping), 2,150.42 cubic inches 1 standard bushel, 268.8 cubic inches 1 standard gallon, 1 cubic foot four-fifths of a bushel.

Metric Weights—10 milligrams 1 centigram, 10 centigrams 1 decigram, 10 decigrams 1 gram, 10 grams 1 dekagram, 10 dekagrams 1 hektogram, 10 hektograms 1 kilogram.

Metric Measures—(One milliliter—Cubic centimeter.)—10 milliliters 1 centiliter, 10 centiliters 1 deciliter, 10 deciliters 1 liter, 10 liters 1 dekaliter, 10 dekaliters 1 hektoliter, 10 hektoliters 1 kiloliter.

Metric Lengths—10 millimeters 1 centimeter, 10 centimeters 1 decimeter, 10 decimeters 1 meter, 10 meters 1 dekameter, 10 dekameters 1 hektometer, 10 hektometers 1 kilometer.

Relative Value of Apothecaries' and Imperial Measure.

Apothecaries.	Imperial.			
1 gallon equals......................	6 pints,	13 ounces,	2 drams,	23 minims.
1 pint "		16 "	5 "	18 "
1 fluid ounce equals......................		1 "	0 "	20 "
1 fluid dram "			1 "	2½ "

PRACTICAL CALCULATIONS.

Short Cuts in Arithmetic—Handy Tables for Ready Reckoning.

TO ASCERTAIN THE WEIGHT OF CATTLE—Measure the girt close behind the shoulder, and the length from the fore part of the shoulder-blade along the back to the bone at the tail, which is in a vertical line with the buttock, both in feet. Multiply the square of the girt, expressed in feet, by ten times the length, and divide the product by three; the quotient is the weight, nearly, of the fore quarters, in pounds avoirdupois. It is to be observed, however, that in very fat cattle the fore quarters will be about one-twentieth more, while in those in a very lean state they will be one-twentieth less than the weight obtained by the rule.

RULES FOR MEASURING CORN IN CRIB, VEGETABLES, ETC., AND HAY IN MOW—This rule will apply to a crib of any size or kind. Two cubic feet of good, sound, dry corn in the ear will make a bushel of shelled corn. To get, then, the quantity of shelled corn in a crib of corn in the ear, measure the length, breadth and height of the crib, inside the rail; multiply the length by the breadth and the product by the height, then divide the product by two, and you have the number of bushels of shelled corn in the crib.

To find the number of bushels of apples, potatoes, etc., in a bin, multiply the length, breadth and thickness together, and this product by eight, and point off one figure in the product for decimals.

To find the amount of hay in a mow, allow 512 cubic feet for a ton, and it will come out very generally correct.

TO MEASURE BULK WOOD—To measure a pile of wood multiply the length by the width, and that product by the height, which will give the number of cubic feet. Divide that product by 128, and the quotient will be the number of cords. A standard cord of wood, it must be remembered, is four feet thick; that is, the wood must be four feet long. Farmers usually go by surface measure, calling a pile of stove wood eight feet long and four feet high a cord. Under such circumstances thirty-two feet would be the divisor.

HOW TO MEASURE A TREE—Very many persons, when looking for a stick of timber, are at a loss to estimate either the height of the tree or the length of timber it will cut. The following rule will enable any one to approximate nearly to the length from the ground to any position desired on the tree: Take a stake, say six feet in length, and place it against the tree you wish to measure. Then step back some rods, twenty or more if you can, from which to do the measuring. At this point a light pole and a measuring rule are required. The pole is raised between the eyes and the tree, and the rule is brought into position against the pole. Then by sighting and observing what length of the rule is required to cover the stake at the tree, and what the entire tree, dividing the latter length by the former and multiplying by the number of feet the stake is long, you reach the approximate height of the tree. For example, if the stake at the tree be six feet above ground and one inch on your rule corresponds exactly with this, and if then the entire height of the tree corresponds exactly with say nine inches on the rule, this would show the tree to possess a full height of fifty-four feet. In practice it will thus be found an easy matter to learn the approximate height of any tree, building, or other such object.

TO MEASURE CASKS OR BARRELS—Find mean diameter by adding to head diameter two-thirds (if staves are but slightly curved, three-fifths) of difference between head and bung diameters, and dividing by two. Multiply square of mean diameter in inches by .7854, and the product by the height of the cask in inches. The result will be the number of cubic inches. Divide by 231 for standard or wine gallons, and by 282 for beer gallons.

GRAIN MEASURE—To find the capacity of a bin or wagon-bed, multiply the cubic feet by .8 (tenths). For great accuracy, add 1/3 of a bushel for every 100 cubic feet. To find the cubic feet, multiply the length, width and depth together.

CISTERN MEASURE—To find the capacity of a round cistern or tank, multiply the square of the average diameter by the depth, and take 3-16 of

the product. For great accuracy, multiply by .1865. For square cisterns or tanks, multiply the cubic feet by .2⅜. The result is the contents in barrels.

LAND MEASURE—To find the number of acres in a body of land, multiply the length by the width (in rods), and divide the product by 160. When the opposite sides are unequal, add them, and take half the sum for the mean length or width.

MEASURES OF CAPACITY—The following table, showing contents of boxes, will often be found convenient, taking inside dimensions:

24 in. x 24 in. x 14.7 will contain a barrel of 31½ gallons.
15 in. x 14 in. x 11 in. will contain 10 gallons.
8¼ in. x 7 in. x 4 in. will contain a gallon.
4 in. x 4 in. x 3.6 in. will contain a quart.
24 in. x 28 in. x 16 in. will contain 5 bushels.
16 in. x 12 in. x 11.2 in. will contain a bushel.
12 in. x 11.2 in. x 8 in. will contain a half bushel.
7 in. x 6.4 in. x 12 in. will contain a peck.
8.4 in. x 8 in. x 4 in. will contain a half peck, or 4 dry quarts.
6 in. x 5 3-5 in., and 4 in. deep, will contain a half gallon.
4 in. x 4 in., and 2 1-10 in. deep, will contain a pint.

Food for Stock.

One hundred pounds of good hay for stock are equal to: Beets, white silesia, 669; turnips, 469; rye straw, 429; clover, red, green, 373; carrots, 371; mangolds, 368½; potatoes, kept in pit, 350; oat straw, 317; potatoes, 360; carrot leaves (tops), 135; hay, English, 100; Lucerne, 89; clover, red, dry, 88; buckwheat, 78½; corn, 62½; oats, 59; barley, 58; rye, 53½; wheat, 44½; oil-cake, linseed, 43; peas, dry, 37½; beans, 28.

Number of Shrubs, Plants or Trees in an Acre.

Distances apart.	No. of Plants.	Distances apart.	No. of Plants.	Distances apart.	No. of Plants.
1 by 1	43,560	5 by 2	4,356	15 by 15	193
1½ " 1½	19,360	5 " 3	2,904	16 " 16	170
2 " 1	21,780	5 " 4	2,178	17 " 17	150
2 " 2	10,890	5 " 5	1,742	18 " 18	134
2½ " 2½	6,969	5½ " 5½	1,417	19 " 19	120
3 " 1	14,520	6 " 6	1,210	20 " 20	108
3 " 2	7,260	6½ " 6½	1,031	24 " 24	75
3 " 3	4,840	7 " 7	888	25 " 25	69
3½ " 3½	3,555	8 " 8	680	27 " 27	59
4 " 1	10,890	9 " 9	537	30 " 30	48
4 " 2	5,445	10 " 10	435	40 " 40	27
4 " 3	3,630	11 " 11	360	50 " 50	17
4 " 4	2,722	12 " 12	302	60 " 60	12
4½ " 4½	2,151	13 " 13	257	66 " 66	10
5 " 1	8,712	14 " 14	222		

The city of Ghent, Belgium, stands on twenty-six islands, connected with each other by eighty bridges. The city of Venice is built on eighty islands, connected by nearly 400 bridges. In Venice canals serve for streets and gondolas for carriages.

Bricks and common pottery ware owe their red color to the iron naturally contained in the clay of which they are formed, the iron, by the action of the heat, being converted into red oxide of iron. Some varieties of clay, like that found near Milwaukee, contain little or no iron, and bricks made from such clay are consequently of a light yellow color.

Barbed Wire Required for Fences.

Estimated number of pounds of barbed wire required to fence space or distances mentioned, with one, two or three lines of wire, based upon each pound of wire measuring one rod ($16\frac{1}{2}$ feet).

	1 Line.	2 Lines.	3 Lines.
1 square acre	$50\frac{2}{3}$ lbs.	$101\frac{1}{3}$ lbs.	152 lbs.
1 side of a square acre......	$12\frac{2}{3}$ lbs.	$25\frac{1}{3}$ lbs.	38 lbs.
1 square half-acre.........	36 lbs.	72 lbs.	108 lbs.
1 square mile	1280 lbs.	2560 lbs.	3840 lbs.
1 side of a square mile.....	320 lbs.	640 lbs.	960 lbs.
1 rod in length............	1 lb.	2 lbs.	3 lbs.
100 rods in length.........	100 lbs.	200 lbs.	300 lbs.
100 feet in length..........	6 1-16 lbs.	$12\frac{1}{8}$ lbs.	18 3-16 lbs.

To Measure Corn or Similar Commodity on a Floor—Pile up the commodity in the form of a cone; find the diameter in feet; multiply the square of the diameter by .7854, and the product by one-third the height of the cone in feet; from this last product deduct one-fifth of itself, or multiply it by .803564, and the result will be the number of bushels.

Contents of Fields and Lots—An acre is 43,560 square feet. The following table will assist farmers in making an accurate estimate of the amount of land in different fields under cultivation:

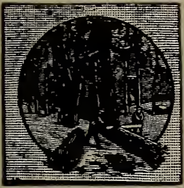
10 rods	×	16 rods	=	1	A.	100 ft.	×	$108\frac{9}{10}$ ft.	=	$\frac{1}{4}$	A.
8 "	×	20 "	=	1	"	25 "	×	100 "	=	.0574	"
5 "	×	32 "	=	1	"	25 "	×	110 "	=	.0631	"
4 "	×	40 "	=	1	"	25 "	×	120 "	=	.0688	"
5 yards	×	968 "	=	1	"	25 "	×	125 "	=	.0717	"
10 "	×	484 yds	=	1	"	25 "	×	150 "	=	.109	"
20 "	×	242 "	=	1	"	2178 square feet			=	.05	"
40 "	×	121 "	=	1	"	4356 " "			=	.10	"
80 "	×	$60\frac{1}{2}$ "	=	1	"	6534 " "			=	.15	"
70 "	×	$69\frac{1}{2}$ "	=	1	"	8712 " "			=	.20	"
220 feet	×	198 feet	=	1	"	10890 " "			=	.25	"
440 "	×	99 "	=	1	"	13068 " "			=	.30	"
110 "	×	369 "	=	1	"	15246 " "			=	.35	"
60 "	×	726 "	=	1	"	17424 " "			=	.40	"
120 "	×	363 "	=	1	"	19603 " "			=	.45	"
240 "	×	$181\frac{1}{2}$ ft.	=	1	"	21780 " "			=	.50	"
200 "	×	$108\frac{9}{10}$ "	=	$\frac{1}{2}$	"	32670 " "			=	.75	"
100 "	×	$145\frac{2}{10}$ "	=	$\frac{1}{3}$	"	34848 " "			=	.80	"

There is a lake of pitch in the island of Trinidad, about a mile and a half in circumference. While the asphaltum near the shores is sufficiently hard at most seasons to sustain men and quadrupeds, it grows soft and warm toward the center, and there it is in a boiling state.

GRADE PER MILE—The following table will show the grade per mile as thus indicated:

An inclination of—

1 foot in	15	is	352	feet	per mile	1 foot in	40	is	132	feet	per mile
1 "	20	is	264	"	"	1 "	50	is	106	"	"
1 "	25	is	211	"	"	1 "	100	is	53	"	"
1 "	30	is	176	"	"	1 "	125	is	42	"	"
1 "	35	is	151	"	"						



TO FIND THE QUANTITY OF LUMBER IN A LOG—Multiply the diameter in inches at the small end by one-half the number of inches, and this product by the length of the log in feet, which last product divide by 12.

Example. How many feet of lumber can be made from a log 30 inches in diameter and 14 feet long?

$30 \times 15 = 450 \times 14 = 6300 \div 12 = 525$ feet. Ans.

TO TELL THE SOUNDNESS OF TIMBER—Apply the ear to the middle of one of the ends, while another party strikes the other end. The blow will be clearly and distinctly heard, however long the beam may be, if the wood is sound and of good quality, but if decay has set in, the sound will be muffled and indistinct. The toughest part of a tree will always be found on the side next the north.

THE NUMBER OF CUBIC FEET IN A ROUND LOG OF UNIFORM DIAMETER—Square the diameter, in inches, multiply by .7854, and multiply this product by the length in feet, divide by 144, and the quotient is the number of cubic feet.

NUMBER OF CUBIC FEET IN THE TRUNK OF A STANDING TREE—Find the circumference in inches, divide by 3.1416, square the quotient, multiply by the length in feet, divide by 144, deduct about one-tenth for thickness of bark, and the result will be, approximately, the number of cubic feet.

Following are some curious facts about fishes. While naturalists have generally accepted Cuvier's view that the existence of fishes is silent, emotionless and joyless, recent observations tend to show that many fishes emit vocal sounds. The *anabas scandens*, the climbing perch of India, quits the water and wanders over banks for considerable distances, and is even said to climb trees and bushes. At Tranquebar, Hindoostan, may be seen the strange spectacle of fish and shell-fish dwelling high on lofty trees. The perch there climbs up tall fan-palms in pursuit of certain shell-fish which form his favorite food. Covered with viscid slime, he glides smoothly over the rough bark. Spines, which he may sheathe and unfold at will, serve him like hands to hang by, and with the aid of side fins and a powerful tail he pushes himself upward. One species of fish, the sticklebacks, are known to build nests. There are several varieties of this fish, all natives of fresh water with one or two exceptions. They are found in the Ottawa River. The cyprinodon is a sightless fish which gropes in the dreary waters of the Mammoth Cave of Kentucky.

ABRAHAM'S purchase of the cave of Machpelah is the first recorded commercial transaction.

Scantling and Timber Measure Reduced to One-Inch Board Measure.

To ascertain the number of feet of scantling or timber, say 18 feet long and 2 by 3 inches: Find 2 by 3 in the top columns, and 18 in the left hand column, and under 2 by 3 and against 18 is 9 feet. If the scantling is longer than contained in the table, add two lengths together. If shorter, take part off same length.

Feet.	THICKNESS AND WIDTH IN INCHES.															
	2x2	2x3	2x4	2x5	2x6	2x7	2x8	2x9	3x3	3x4	3x5	3x6	3x7	3x8	3x9	4x4
6	2.	3.	4.	5.	6.	7.	8.	9.	4.6	6.	7.6	9.	10.6	12.	13.6	8.
7	2.4	3.6	4.8	5.10	7.	8.2	9.4	10.6	5.3	7.	8.9	10.6	12.3	14.	15.9	9.4
8	2.8	4.	5.4	6.8	8.	9.4	10.8	12.	6.	8.	10.	12.	14.	16.	18.	10.
9	3.	4.6	6.	7.6	9.	10.6	12.	13.6	6.9	9.	11.3	13.6	15.9	18.	20.3	12.
10	3.4	5.	6.8	8.4	10.	11.8	13.5	15.	7.6	10.	12.6	15.	17.6	20.	22.6	13.4
11	3.8	5.6	7.4	9.2	11.	12.10	14.8	16.6	8.3	11.	13.9	16.6	19.3	22.	24.9	14.8
12	4.	6.	8.	10.	12.	14.	16.	18.	9.	12.	15.	18.	21.	24.	27.	16.
13	4.4	6.6	8.8	10.10	13.	15.2	17.4	19.6	9.9	13.	16.3	19.6	22.9	26.	29.3	17.4
14	4.8	7.	9.4	11.8	14.	16.4	18.8	21.	10.6	14.	17.6	21.	24.6	28.	31.6	18.8
15	5.	7.6	10.	12.6	15.	17.6	20.	22.6	11.3	15.	18.9	22.6	26.3	30.	33.9	20.
16	5.4	8.	10.8	13.4	16.	18.8	21.4	24.	12	16.	20.	24.	28.	32.	36.	21.4
17	5.8	8.6	11.4	14.2	17.	19.10	22.8	25.6	12.9	17.	21.3	25.6	29.9	34.	38.3	22.8
18	6.	9.	12.	15.	18.	21.	24.	27.	13.6	18.	22.6	27.	31.6	36.	40.6	24.
19	6.4	9.6	12.8	15.10	19.	22.2	25.4	28.6	14.3	19.	23.9	28.6	33.3	38.	42.9	24.4
20	6.8	10.	13.4	16.8	20.	23.4	26.8	30.	15.	20.	25.	30.	35.	40.	45.	26.8
21	7.	10.6	14.	17.6	21.	24.6	28.	31.6	15.9	21.	26.3	31.6	36.9	42.	47.3	28.
22	7.4	11.	14.8	18.4	22.	25.8	29.4	33.	16.6	22.	27.6	33.	38.6	44.	49.6	29.4
23	7.8	11.6	15.4	19.2	23.	26.10	30.8	34.6	17.3	23.	28.9	34.6	40.3	46.	51.9	30.8
24	8.	12.	16.	20.	24.	28.	32.	36.	18.	24.	30.	36.	42.	48.	54.	32.
25	8.4	12.6	16.8	20.10	25.	29.2	33.4	37.6	18.9	25.	31.3	37.6	43.9	50.	56.3	33.4
30	10.	15.	20.	25.	30.	35.	40.	45.	22.6	30.	37.6	45.	52.6	60.	67.6	40.
34	11.4	17.	22.8	28.4	34.	39.3	45.4	51.	25.6	34.	42.6	51.	59.6	68.	76.6	45.4
40	13.4	20.	26.8	33.4	40.	46.8	53.4	60.	30.	40.	50.	60.	70.	80.	90.	53.

Feet.	THICKNESS AND WIDTH IN INCHES.														
	5x4	4x6	4x7	4x8	4x9	5x5	5x6	5x7	5x8	5x9	6x6	6x7	6x8	6x9	6x10
6	10.	12.	14.	16.	18.	12.6	15.	17.6	20.	22.6	18.	21.	24.	27.	30.
7	11.8	14.	16.4	18.8	21.	14.7	17.6	20.5	23.4	26.3	21.	24.6	28.	31.6	35.
8	13.4	16.	18.8	21.4	24.	16.8	20.	23.4	26.8	30.	24.	28.	32.	36.	40.
9	15.	18.	21.	24.	27.	18.9	22.6	26.3	30.	33.9	27.	31.6	36.	40.6	45.
10	16.8	20.	23.4	26.8	30.	20.10	25.	29.2	33.4	37.6	30.	35.	40.	45.	50.
11	18.4	22.	25.8	29.4	33.	22.11	27.6	32.1	36.8	41.3	33.	38.6	44.	49.6	55.
12	20.	24.	28.	32.	36.	25.	30.	35.	40.	45.	36.	42.	48.	54.	60.
13	21.8	26.	30.4	34.8	39.	27.1	32.6	37.11	43.4	48.9	39.	45.6	52.	58.6	65.
14	23.4	28.	32.8	37.4	42.	29.2	35.	40.10	46.8	52.6	42.	49.	56.	63.	70.
15	25.	30.	35.	40.	45.	31.3	37.6	43.9	50.	56.3	45.	52.6	60.	67.6	75.
16	26.8	32.	37.4	42.8	48.	33.4	40.	46.8	53.4	60.	48.	56.	64.	72.	80.
17	28.4	34.	39.8	45.4	51.	35.5	42.6	49.7	56.8	63.9	51.	59.6	68.	76.6	85.
18	30.	36.	42.	48.	54.	37.6	45.	52.6	60.	67.6	54.	63.	72.	81.	90.
19	31.8	38.	44.4	50.8	57.	39.7	47.6	55.5	63.4	71.3	57.	66.6	76.	85.6	95.
20	33.4	40.	46.8	53.4	60.	41.8	50.	58.4	66.8	75.	60.	70.	80.	90.	100.
21	35.	42.	49.	56.	63.	43.9	52.6	61.3	70.	78.9	63.	73.6	84.	94.6	105.
22	36.8	44.	51.4	58.8	66.	45.10	55.	64.2	73.4	82.6	66.	77.	88.	99.	110.
23	38.4	46.	53.8	61.4	69.	47.11	57.6	67.1	76.8	86.3	69.	80.6	92.	103.6	115.
24	40.	48.	56.	64.	72.	50.	60.	70.	80.	90.	72.	84.	96.	108.	120.
25	41.8	50.	58.4	66.8	75.	52.1	62.6	72.11	83.4	93.9	75.	87.6	100.	112.6	125.
30	50.	60.	70.	80.	90.	62.6	75.	87.6	100.	112.6	90.	105.	120.	135.	150.
34	56.8	68.	79.4	90.8	102.	70.10	85.	99.2	113.4	127.6	102.	119.	136.	153.	170.
40	66.8	80.	93.4	106.8	120.	83.4	100.	116.8	133.4	150.	120.	140.	160.	180.	200.

Logs Reduced to Inch Board Measure

Find the length of the log in feet in the left hand column, and its mean diameter in inches (found by adding the two end diameters and dividing their sum by two) at the heads of the other columns, and trace them until they meet, and the figures so found will express the diameter of feet board measure of inch boards the log will measure.

L. Feet..	Diam. 12	Diam. 13	Diam. 14	Diam. 15	Diam. 16	Diam. 17	Diam. 18	Diam. 19	Diam. 20	Diam. 21	Diam. 22	Diam. 23	Diam. 24	Diam. 25	Diam. 26	Diam. 27	Diam. 28
10	49	61	72	89	99	116	133	150	175	190	209	235	252	287	313	342	363
11	54	67	79	98	109	127	147	165	192	209	230	259	278	315	344	377	400
12	59	73	86	107	119	139	160	180	210	228	251	283	303	344	373	411	436
13	64	79	93	116	129	150	173	195	227	247	272	306	328	373	408	445	473
14	69	85	100	125	139	162	187	210	245	266	292	330	353	401	439	479	509
15	74	91	107	134	149	173	200	225	262	285	313	353	379	430	469	514	545
16	79	97	114	142	159	185	213	240	280	304	334	377	404	459	500	548	582
17	81	103	122	151	168	196	227	255	297	323	355	400	429	478	531	582	618
18	88	109	129	160	178	208	240	270	315	342	376	424	454	516	562	616	654
19	93	116	136	169	188	219	253	285	332	361	397	447	480	545	594	650	692
20	98	122	143	178	198	232	267	300	350	380	418	470	505	573	625	684	728
21	103	128	150	187	208	243	280	315	368	399	439	495	530	602	656	719	764
22	108	134	157	196	218	255	293	330	385	418	460	518	555	631	688	753	800
23	113	140	164	205	228	266	307	345	403	437	480	542	581	659	719	787	837
24	118	146	172	214	238	278	320	360	420	456	501	566	606	688	750	821	873
25	123	152	179	223	248	289	333	375	438	475	522	589	631	717	781	856	910

L. Feet..	Diam. 29	Diam. 30	Diam. 31	Diam. 32	Diam. 33	Diam. 34	Diam. 35	Diam. 36	Diam. 37	Diam. 38	Diam. 39	Diam. 40	Diam. 41	Diam. 42	Diam. 43
10	381	411	448	460	490	500	547	577	644	669	700	752	795	840	872
11	419	451	448	506	539	550	602	634	708	734	770	828	874	924	959
12	457	493	532	552	588	600	657	692	772	801	840	903	954	1007	1046
13	495	534	570	598	637	650	712	750	836	868	910	978	1033	1091	1135
14	533	575	622	644	686	700	766	807	901	934	980	1053	1113	1175	1222
15	571	616	666	690	735	750	821	865	965	1001	1050	1129	1192	1259	1309
16	609	657	710	736	784	800	876	923	1029	1068	1120	1204	1272	1343	1396
17	647	698	755	782	833	850	931	980	1094	1134	1190	1279	1351	1427	1485
18	685	739	799	828	882	900	985	1038	1158	1201	1260	1354	1431	1511	1571
19	723	780	843	874	931	950	1040	1096	1222	1268	1330	1430	1510	1595	1658
20	761	821	888	920	980	1000	1095	1152	1287	1335	1400	1505	1590	1679	1745
21	800	863	932	966	1029	1050	1150	1210	....	....	.....	.....	.....	.....	.....
22	838	904	976	1012	1078	1100	1204	1268	....	....	.....	.....	.....	.....	.....
23	876	945	1021	1058	1127	1150	1259	1322	....	....	.....	.....	.....	.....	.....
24	914	986	1065	1104	1176	1200	1314	1380	....	....	.....	.....	.....	.....	.....
25	952	1027	1109	1150	1225	1250	1369	1438	....	....	.....	.....	.....	.....	.....

THE Falls of Niagara have cut a channel through the solid rocks 200 feet deep, 1,200 to 2,000 feet wide and seven miles long. The evidence is conclusive that the falls were formerly at Queenstown, seven miles below their present sitüation. It has been shown that they have receded not more than a foot a year for the past half century.

ALEXANDER THE GREAT was born in Europe, died in Asia, and was buried in Africa. The preparations for his funeral consumed two years' time. The immense car containing the golden sarcophagus was drawn by sixty-four white mules, richly caparisoned, a distance of a thousand miles—from the Euphrates to the Nile.

BOARD AND PLANK MEASUREMENT AT SIGHT.

This table gives the square feet and inches in boards or planks from 3 to 25 inches wide, and 4 to 20 feet long. If a board be longer than 20 feet, or wider than 25 inches, unite two of the numbers.

LENGTH, -	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	11 ft.	12 ft.	13 ft.	14 ft.	15 ft.	16 ft.	17 ft.	18 ft.	19 ft.	20 ft.
WIDTH.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft in.
3 in.........	1..00	1..03	1..06	1..09	2..00	2..03	2..06	2..09	3..00	3..03	3..06	3..09	4..00	4..03	4..06	4..09	5..00
4 in.........	1..04	1..08	2..00	2..04	2..08	3..00	3..04	3..08	4..00	4..04	4..08	5..00	5..04	5..07	6..00	6..04	6..08
5 in.........	1..08	2..01	2..06	2..11	3..04	3..09	4..02	4..07	5..00	5..05	5..10	6..03	6..08	7..01	7..03	7..11	8..04
6 in.........	2..00	2..06	3..00	3..06	4..00	4..06	5..00	5..06	6..00	6..06	7..00	7..06	8..00	8..06	9..00	9..06	10..00
7 in.........	2..04	2..11	3..06	4..01	4..08	5..03	5..10	6..05	7..00	7..07	8..02	8..09	9..04	9..11	10..06	11..01	11..08
8 in.........	2..08	3..04	4..06	4..08	5..04	6..00	6..08	7..04	8..00	8..08	9..04	10..00	10..08	11..04	12..00	12..08	13..04
9 in.........	3..00	3..09	4..00	5..03	6..00	6..09	7..06	8..03	9..00	9..09	10..06	11..03	12..00	12..09	13..06	14..03	15..00
10 in.........	3..04	4..02	5..06	5..10	6..08	7..06	8..04	9..02	10..00	10..10	11..08	12..06	13..04	14..02	15..00	15..10	16..08
11 in.........	3..08	4..07	5..00	6..05	7..04	8..03	9..02	10..01	11..00	11..11	12..10	13..09	14..08	15..07	16..06	17..05	18..04
12 in.........	4..00	5..00	6..00	7..00	8..00	9..00	10..00	11..00	12..00	13..00	14..00	15..00	16..00	17..00	18..00	19..00	20..00
13 in.........	4..04	5..05	6..00	7..07	8..08	9..09	10..10	11..11	13..00	14..01	15..02	16..03	17..04	18..05	19..06	20..07	21..08
14 in.........	4..08	5..10	7..06	8..02	9..04	10..06	11..08	12..10	14..00	15..02	16..04	17..06	18..08	19..10	21..00	22..02	23..04
15 in.........	5..00	6..03	7..00	8..09	10..00	11..03	12..03	13..09	15..00	16..03	17..06	18..09	20..00	21..03	22..06	23..09	25..00
16 in.........	5..04	6..08	8..00	9..04	10..08	12..00	13..04	14..08	16..00	17..04	18..08	20..00	21..04	22..08	24..00	25..04	26..08
17 in.........	5..08	7..01	8..06	9..11	11..04	12..09	14..02	15..07	17..00	18..05	19..10	21..03	22..08	24..01	25..06	26..11	28..04
18 in.........	6..00	7..06	9..00	10..06	12..00	13..06	15..00	16..06	18..00	19..06	21..00	22..06	24..00	25..06	27..00	28..06	30..00
19 in.........	6..04	7..11	9..06	11..01	12..08	14..03	15..10	17..05	19..00	20..07	22..02	23..09	25..04	26..11	28..06	30..01	31..08
20 in.........	6..08	8..04	10..00	11..08	13..04	15..00	16..08	18..04	20..00	21..08	23..04	25..00	26..08	28..04	30..00	31..08	33..04
21 in.........	7..00	8..09	10..06	12..03	14..00	15..09	17..06	19..03	21..00	22..09	24..06	26..03	28..00	29..09	31..06	33..03	35..00
22 in.........	7..04	9..02	11..00	12..10	14..08	16..06	18..04	20..02	22..00	23..10	25..08	27..06	29..04	31..02	33..00	34..10	36..08
23 in.........	7..08	9..07	11..06	13..05	15..04	17..03	19..02	21..01	23..00	24..11	26..10	28..09	30..08	32..07	34..06	36..05	38..04
24 in.........	8..00	10..00	12..00	14..00	16..00	18..00	20..00	22..00	24..00	26..00	28..00	30..00	32..00	34..00	36..00	38..00	40..00
25 in.........	8..04	10..05	12..06	14..07	16..08	18..09	20..10	22..11	25..00	27..01	29..02	31..03	33..04	35..05	37..06	39..07	41..08

EXPLANATION.—To ascertain the number of feet, multiply the number of feet in length by the number of inches in width, and divide the product by 12; the result will be the number in feet and inches. Thus, multiply 9 inches wide by 26 feet long, and the result will be 234. Divide this by 12 and we have the product 19 feet and 6 inches.

Table For Gold Miners.

To ascertain the quantity of gold in any bulk of ore it is not necessary to reduce the mass. A proportional reduction will suffice, and the following table is based on trials of four hundred grains of ore:

If 400 Grains of Ore give Fine Gold,	One Ton of Ore Will Yield			If 400 Grains of Ore give Fine Gold,	One Ton of Ore Will Yield		
Grains.	Oz.	Dwts.	Grs.	Grains.	Oz.	Dwts.	Grs.
.001	0	1	15	.200	16	6	16
.002.	0	3	6	.300	24	10	0
.003	0	4	21	.400	32	13	8
.004.........	0	6	12	.500	40	16	16
.005.	0	8	4	.600	49	0	0
.006	0	9	19	.700	57	3	8
.007.........	0	11	10	.800	65	6	16
.008.	0	13	1	.900	73	10	0
.009.........	0	14	16	1.000	81	13	8
.010	0	16	8	2.000	163	16	16
.020.........	1	12	16	3.000	245	0	0
.030.	2	9	0	4.000	326	13	8
.040	3	5	8	5.000	408	6	16
.050........	4	1	16	6.000	490	0	0
.060.	4	18	0	7.000	570	13	8
.070	5	14	8	8.000	653	6	16
.080.........	6	10	16	9.000	735	0	0
.090.	7	7	0	10.000	816	13	8
.100.........	8	3	8	20.000	1633	6	16

The sayings of the Seven Wise Men are the famous mottoes inscribed in the temple of Apollo at Delphi: Solon of Athens—"Know thyself.' Chilo of Sparta—"Consider the end." Thales of Miletus—"Suretyship is the precursor of ruin." Bias of Priene—"Most men are bad." Cleobulus of Lindus—"Avoid excess." Pittacus of Mitylene—"Know thy opportunity." Periander of Corinth—"Nothing is impossible to industry."

The "Wandering Jew" was last seen in the seventeenth century. On January 1, 1644, he appeared at Paris and created a great sensation among all ranks. He claimed to have lived sixteen hundred years and to have traveled through all regions of the world. He was visited by many prominent personages, and no one could accost him in a language of which he was ignorant. He replied readily and without embarrassment to any questions propounded, and he was never confounded by any amount of cross-questioning. He seemed familiar with the history of persons and events from the time of Christ, and claimed an acquaintance with all the celebrated characters of sixteen centuries. Of himself he said that he was usher of the court of judgment in Jerusalem, where all criminal cases were tried at the time of our Saviour; that his name was Michab Ader; and that for thrusting Jesus out of the hall with these words, "Go, why tarriest thou?" the Messiah answered him, "I go, but tarry thou till I come," thereby condemning him to live till the day of judgment. The learned looked upon him as an impostor or madman, yet took their departure bewildered and astonished.

Brick Required to Construct Any Building.

(Reckoning 7 brick to each superficial foot.)

Superficial Feet of Wall.	Number of Bricks to Thickness of					
	4 in.	8 in.	12 in.	16 in.	20 in.	24 in.
1	7	15	23	30	38	45
2	15	30	45	60	75	90
3	23	45	68	90	113	135
4	30	60	90	120	150	180
5	38	75	113	150	188	225
6	45	90	135	180	225	270
7	53	105	158	210	263	315
8	60	120	180	240	300	360
9	68	135	203	270	338	405
10	75	150	225	300	375	450
20	150	300	450	600	750	900
30	225	450	675	900	1125	1350
40	300	600	900	1200	1500	1800
50	375	750	1125	1500	1875	2250
60	450	900	1350	1800	2250	2700
70	525	1050	1575	2100	2625	3150
80	600	1200	1800	2400	3000	3600
90	675	1350	2025	2700	3375	4050
100	750	1500	2250	3000	3750	4500
200	1500	3000	4500	6000	7500	9000
300	2250	4500	6750	9000	11250	13500
400	3000	6000	9000	12000	15000	18000
500	3750	7500	11250	15000	18750	22500
600	4500	9000	13500	18000	22500	27000
700	5250	10500	15750	21000	26250	31500
800	6000	12000	18000	24000	30000	36000
900	6750	13500	20250	27000	33750	40500
1000	7500	15000	22500	30000	37500	45000

Facts for Builders.

1,000 shingles, laid 4 inches to the weather, will cover 100 sq. ft. of surface, and 5 lbs. of shingle nails will fasten them on.

One-fifth more siding and flooring is needed than the number of square feet of surface to be covered, because of the lap in the siding and matching.

1,000 laths will cover 70 yards of surface, and 7 lbs. of lath nails will nail them on. Eight bushels of good lime, 16 bushels of sand, and 1 bushel of hair will make enough good mortar to plaster 100 square yards.

A cord of stone, 3 bushels of lime, and a cubic yard of sand, will lay 100 cubic feet of wall.

Cement 1 bushel and sand 2 bushels will cover 3½ square yards 1 inch thick, 4½ square yards ¾ inch thick, 6¾ square yards ½ inch thick. 1 bu. cement and one of sand will cover 2¼ square yards 1 inch thick, 3 square yards ¾ inch thick, and 4½ square yards ½ inch thick.

Five courses of brick will lay 1 foot in height on a chimney. 8 bricks in a course will make a flue 4 ins. wide and 12 ins. long, and 16 bricks in a course will make a flue 8 ins wide and 16 ins. long.

Twenty-two cubic feet of stone, when built into the wall, is 1 perch.

Three pecks of lime and four bushels of sand are required to each perch of wall.

There are 20 common bricks to a cubic foot when laid; and 15 common bricks to a foot of 8-inch wall when laid.

Fifty feet of boards will build one rod of fence five boards high, first board being 10 inches wide, second 8 inches, third 7 inches, fourth 6 inches, fifth 5 inches.

Useful Facts for Bricklayers and Plasterers.

The average weight of smaller-sized bricks is about 4 lbs.; of the larger about 6 lbs.

Dry bricks will absorb about one-fifteenth of their weight in water.

A load of mortar measures a cubic yard, or 27 cubic ft.; requires a cubic yard of sand and 9 bus. of lime and will fill 30 hods.

A bricklayer's hod 1 ft. 4 in. by 9 in. by 9 in. equals 1,296 cubic in. in capacity, and contains 20 bricks.

A single load of sand and other materials equals a cubic yard, or 27 cubic ft.; a double load twice that quantity.

One thousand bricks, closely stacked, occupy about 56 cubic ft. One thousand old bricks, cleaned and loosely stacked, occupy about 72 cubic feet.

One superficial foot of gauged arches requires ten bricks.

One superficial foot of facings requires seven bricks.

One yard of paving requires 36 stock bricks laid flat, or 52 on edge, and 36 paving bricks laid flat, or 82 on edge.

The bricks of different makers vary in dimensions, and those of the same maker vary also, owing to varying degrees of heat in burning. The calculations given above are therefore approximate.

One hundred yards of plastering will require 1,400 laths, 4½ bus. lime, four-fifths of a load of sand, 9 lbs. hair, and 9 lbs. nails, for two-coat work.

Three men and one helper will put on 450 yards, in a day's work, of two-coat work, and will put on a hard finish for 300 yards.

A bushel of hair weighs, when dry, about 15 lbs.

Putty, for Plastering, is a very fine cement made of lime only. It is thus prepared: Dissolve in a small quantity of water, as two or three gallons, an equal quantity of fresh lime, constantly stirring it with a stick until the lime be entirely slacked, and the whole becomes of a suitable consistency, so that when the stick is taken out of it, it will but just drop therefrom; this, being sifted or run through a hair sieve, to take out the gross parts of the lime, is fit for use. Putty differs from fine stuff in the manner of preparing it, and its being used without hair.

To Find the Number of Bricks Required in a Building—Rule—Multiply the number of cubic feet by 22½. The number of cubic feet is found by multiplying the length, height and thickness (in feet) together. Bricks are usually made 8 inches long, 4 inches wide and 2 inches thick; hence it requires 27 bricks to make a cubic foot without mortar, but it is generally assumed that the mortar fills 1-6 of the space.

Estimates of Materials.—3½ barrels of lime will do 100 square yards plastering, two coats.

2 barrels of lime will do 100 square yards plastering, one coat.

1½ bushels of hair will do 100 square yards plastering.

1¼ yards good sand will do 100 square yards plastering.

⅓ barrel of plaster (stucco) will hard-finish 100 square yards plastering.

1 barrel of lime will lay 1,000 bricks. (It takes good lime to do it.)

2 barrels of lime will lay 1 cord rubble stone.

½ barrel of lime will lay 1 perch rubble stone (estimating ¼ cord to perch).

To every barrel of lime estimate about ⅝ yards of good sand for plastering and brick work.

Mason Work—Brick.—1⅛ barrels lime and ⅝ yard sand will lay 1,000 brick.

One man with 1¼ tenders will lay 1,800 to 2,000 brick per day.

Rubble.—1¼ barrels lime and 1 yard of sand will lay 100 feet of stone.

One man will lay 150 feet of stone per day with one tender.

Cement.—1¼ barrels cement and ¾ yard sand will lay 100 feet rubble stone. Same time as to mason and tender as rubble.

Floor, Wall and Roof Measure.—To find the number of square yards in a floor or wall: Rule—Multiply the length by the width or height in feet) and divide the product by 9; the result will be square yards.

Big Salaries.—There are a score of men in New York who are paid as much for their services each year as the President of the United States. Forty thousand dollars a year is a very tidy salary. There are hundreds of men who get $25,000 a year salary, and the number who get from $10,000 to $20,000 are legion. Very ordinary men get from $5,000 to $8,000 a year, or as much as a Cabinet officer. Dr. Norvin Green, president of the Western Union Telegraph Company, is paid $50,000. So is Chauncey M. Depew, president of the New York Central Railroad. Richard M. McCurdy, president of the Mutual Life Insurance Company, gets a like amount. John Hoey, president of Adams Express Company, fares equally as well. President Henry B. Hyde, of the Equitable Life Insurance Company, is also on the list. George G. Williams, president of the Chemical National Bank, the richest banking institution in America, with nearly $5,000,000 of surplus, $20,000,000 average deposits, is paid a salary of $25,000 yearly. President Potts of the Paris Bank and President Tappan of the Gallatin National Bank receive a like sum each twelve months. The best paid minister in New York is Dr. John Hall, a brainy man from the north of Ireland, who preaches to $20,000,000 every Sunday. His is the smallest church in town. He owes his rise in life to Robert Bonner of the *Ledger*, who found him preaching to a small delegation in Dublin, and induced him to come to America. He gets a salary of $20,000 a year and makes $5,000 by his newspaper and magazine articles. He is given a luxuriously furnished house as well. Dr. Morgan Dix, the chief pastor of Trinity Church corporation, the wealthiest in America, receives $15,000 yearly. Dr. William L. Taylor, of the Broadway Tabernacle, gets the same amount. He does literary work and lecturing that brings his income up to $20,000. Dr. Charles Hall, of the Fifth Avenue Presbyterian Church, is paid $15,000. He is very eloquent, and his church is crowded at all services. Dr. Parkhurst, of Madison Square Church, gets $12,000. He has a large and distinguished congregation. Cyrus W. Field is one of the pillars of the church. Dr. Paxton, who preaches to Jay Gould and others less wealthy, is paid $15,000. The Rev. Robert Collyer, the blacksmith preacher, is paid $10,000.

BUILDERS' ESTIMATING TABLES.

Quantity of material in every four lineal feet of exterior wall in a balloon frame building, height of wall being given:

Length of Studs.	Size of Sills.	Size of Studs, Braces, etc.	Quantity of Rough Lumber.	Quantity of Inch Boarding.	Siding in sup. feet.	Tar Paper in sup. feet.
8	6x 6	2x4 Studs	42	36	40	74
10	6x 8	4x4 Braces	52	44	50	80
12	6x10	4x4 Plates	62	53	60	96
14	6x10	1x6 Ribbons	69	62	70	112
16	8x10		82	71	80	128
18	8x10	Studs	87	80	90	144
20	8x12	16 inches from	98	88	100	160
22	9x12	centers	109	97	110	176
24	10x12		119	106	120	192
18	10x10	2x6 Studs	122	80	90	144
20	10x12	6x6 Braces	137	88	100	160
22	10x12	4x6 Plates	145	97	110	176
24	12x12	1x6 Ribbons	162	106	120	192
26	10x14		169	114	130	208
28	10x14	Studs 16 inch centers	176	123	140	224
30	12x14		198	132	150	240

Amount of lumber in rafters, collar-piece and boarding, and number of shingles to four lineal feet of roof, measured from eave to eave over ridge. Rafters 16-inch centers:

Width of House, Feet.	Size of Rafters.	Size of Collar-piece.	Quantity of Lumber in Rafter and Collar-piece.	Quantity of Boarding, Feet.	No. of Shingles.
14	2x4	2x4	39	91	560
16	2x4	2x4	45	70	640
18	2x4	2x4	50	79	720
20	2x4	2x4	56	88	800
22	2x4	2x4	62	97	880
24	2x4	2x4	67	106	960
20	2x6	2x6	84	88	800
22	2x6	2x6	92	97	880
24	2x6	2x6	101	106	960
26	2x6	2x6	109	115	1040
28	2x6	2x6	117	124	1120
30	2x6	2x6	126	133	1200

Comparative Strength of Timber and Cast Iron.

Table showing the transverse strength of timber and of cast iron one foot long and one inch square.

MATERIAL.	Breaking Weight, lbs.	Weight Borne with Safety, lbs.
Ash, seasoned	175	105
Chestnut, seasoned	170	115
Hickory, seasoned	270	200
White Oak, seasoned	240	196
White Pine, seasoned	135	95
Yellow Pine, seasoned	150	100
Iron (cast)	5,781	4,000

HAND OF DOORS.

Figure 1, Right Hand. | Figure 2, Left Hand. | Figure 3, Right Hand Reverse Bevel. | Figure 4, Lef tHand Reverse Bevel.

Illustration showing hand of doors, and how Rabbeted and Beveled Front Locks should be ordered. The "Hand" is determined by the butt side. Upon approaching the door from the outside or corridor, if the door swings in and the butts are on the right hand side, as in Figure 1, it requires a Right Hand Lock. Figure 2 requires a Left Hand Lock.

Should the door swing to outside or into corridor, hinged on right hand side (Figure 3), it requires a Right Hand Reverse Bevel Lock. Figure 4 requires a Left Hand Reverse Bevel Lock.

When ordering Cylinder Locks of any kind, the thickness and hand of doors should always be stated.

PANES OF WINDOW GLASS IN A BOX OF 50 FEET.

Size, in inches.	Panes in box.	Size, in inches.	Panes in box.	Size, in inches.	Panes in box.	Size, in inches.	Panes in box.
6 x 8	150	12 x 19	32	16 x 20	23	24 x 44	7
7 x 9	115	12 x 20	30	16 x 22	21	24 x 50	6
8 x 10	90	12 x 21	29	16 x 24	19	24 x 56	5
8 x 11	82	12 x 22	27	16 x 30	15	26 x 36	8
8 x 12	75	12 x 23	26	16 x 36	13	26 x 40	7
9 x 10	80	12 x 24	25	16 x 40	11	26 x 48	6
9 x 11	73	13 x 14	40	18 x 20	20	26 x 54	5
9 x 12	67	13 x 15	37	18 x 22	18	28 x 34	8
9 x 13	62	13 x 16	35	18 x 24	17	28 x 40	7
9 x 14	57	13 x 17	33	18 x 26	16	28 x 46	6
9 x 15	53	13 x 18	31	18 x 34	12	28 x 50	5
9 x 16	50	13 x 19	29	18 x 36	11	30 x 40	6
10 x 10	72	13 x 20	28	18 x 40	10	30 x 44	6
10 x 12	60	13 x 21	26	18 x 44	9	30 x 48	5
10 x 13	55	13 x 22	25	20 x 22	16	30 x 54	4
10 x 14	52	13 x 24	23	20 x 24	15	32 x 42	6
10 x 15	48	14 x 15	34	20 x 25	14	32 x 44	5
10 x 16	45	14 x 16	32	20 x 26	14	32 x 46	5
10 x 17	42	14 x 18	29	20 x 28	13	32 x 48	5
10 x 18	40	14 x 19	27	20 x 30	12	32 x 50	5
11 x 11	59	14 x 20	26	20 x 34	11	32 x 54	4
11 x 12	55	14 x 22	24	20 x 36	10	32 x 56	4
11 x 13	50	14 x 24	22	20 x 40	9	32 x 60	4
11 x 14	47	14 x 28	19	20 x 44	8	34 x 40	6
11 x 15	44	14 x 32	16	20 x 50	7	34 x 44	5
11 x 16	41	14 x 36	14	22 x 24	14	34 x 46	5
11 x 17	39	14 x 40	13	22 x 26	13	34 x 50	4
11 x 18	37	15 x 16	30	22 x 28	12	34 x 52	4
12 x 12	50	15 x 18	27	22 x 36	9	34 x 56	4
12 x 13	46	15 x 20	24	22 x 40	8	36 x 44	5
12 x 14	43	15 x 22	22	22 x 50	7	36 x 50	4
12 x 15	40	15 x 24	20	24 x 28	11	36 x 56	4
12 x 16	38	15 x 30	16	24 x 30	10	36 x 60	3
12 x 17	35	15 x 32	15	24 x 32	10	36 x 64	3
12 x 18	34	16 x 18	25	24 x 36	9	40 x 60	3

CARPENTERS' WORK AND MEASURING.

What is called *Naked Flooring* in carpentry are the joists which support the flooring boards and ceiling of a room. There are different kinds, but they may all be comprised in the three following—viz.: single joisted floors, double floors, and framed floors.

A single joisted floor consists of only one series of joists; sometimes every third or fourth joist is made deeper, with ceiling joists nailed across at right angles. This is a good method, as ceilings stand better than when the laths are nailed to the joists alone.

A double floor consists of binding, bridging, and ceiling joists; the binding joists are the chief support of the floor, and the bridging joists are nailed upon the upper side of them; the ceiling joists are either notched to the under side or framed between

with chased mortises. The best method is to notch them.

Framed floors differ from double floors only in having the binding joists framed into large pieces of timber called *girders.*

Single joisted floors, when the bearing exceeds ten feet, should be cross-bridged between the joists to prevent them from turning or twisting sideways, and also to stiffen the floor; when the bearing exceeds fifteen feet, two rows will be necessary, and so on, adding another row for each five feet bearing.

Single joisting may be used to any extent for which timber can be got deep enough; but where it is desirable to have a perfect ceiling, the bearing should not exceed 18 ft., nor the distance from center to center be more than 16 inches; otherwise the bearing for the laths become too long to produce good work.

To find the depth of a joist, the length of bearing and the thickness being given—

RULE.—Divide the square of the length in feet by the thickness in inches, and the cube root of the quotient, multiplied by 2.2 for pine, or 2.3 for oak, will be the depth in inches.

Example.—Suppose a joist whose bearing is 10 feet, and the thickness two inches, what will be the depth?

Here $10 \times 10 = 100$, divided by 2, the thickness$=50$, the cube root of which is $3,684 \times 2.2 = 8.1048 =$equals 8 inches, the depth.

To find the scantlings of joists for different bearings from 5 to 20 feet, at several thicknesses, refer to the table on following page.

Girders are the chief support of a framed floor, and their depth is often limited by the size of the timber; therefore the method of finding the scantling may be divided in two cases—

CASE 1.—To find the depth of a girder when the length of bearing and thickness of girder are given.

Rule.—Divide the square of the length in feet by the thickness in inches, and the cube root of the quotient, multiplied by 4.2 for pine, or 4.34 for oak, will give the depth required in inches.

CASE 2.—To find the thickness when the length of bearing and depth are given.

Rule.—Divide the square of the length in feet by the cube or the depth in inches, and the quotient multiplied by 74 for pine, or by 82 for oak, will give the thickness in inches.

In these rules the girders are supposed to be ten feet apart, and this distance should never be exceeded, but should the distance apart be more or less than 10 feet, the thickness should be made proportionate thereto.

Length of bearing in Feet.	Thickness 2 inches. Depth in inches.	Thickness 2½ inches. Depth in inches.	Thickness 3 inches. Depth in inches.	Thickness 3½ inches. Depth in inches.	Thickness 4 inches. Depth in inches.
5	5¼	4¾	4⅜	4⅛	4
6	5¾	5⅜	5	4¾	4½
7	6½	6	5½	5¼	5
8	7	6½	6¼	5⅞	5¾
9	7½	6⅞	6½	6	5⅞
10	8	7½	7	6¾	6½
11	8¾	8	7½	7	6¾
12	9½	8½	8	7½	7¼
13	9¾	9	8½	8	7¾
14	10	9½	9	8½	8
15	10½	9¾	9¼	8¾	8½
16	11	10½	9¾	9¼	8⅞
17	11½	10¾	10¼	9¾	9¼
18	12	11¼	10½	10	9½
19	12½	11½	10¾	10¼	10
20	13	12	11¼	10¾	10¼

When the breadth of girders is considerable it is an excellent method to saw them down the middle and bolt them together, with the sawn sides outward.

Partitions unsupported from underneath the floors should be supported from the walls by means of a simple truss. This can be made by setting two pieces of scantling into the walls on either side at the floor to abut against each other at the ceiling or against a collar-beam over the doors. This plan will obviate the sinking of floors so often seen under partitions.

Weight of Lumber, Etc., Dry.

Flooring—Dressed and matched, per 1,000 ft.	1,800	lbs.
Siding—Dressed per 1,000 ft.	800	"
Ceiling—⅜ inch thick, per 1,000 ft.	800	"
" ½ " " " "	900	"
Boards—Dressed one side, per 1,000 ft.	2,100	"
" and dimensions, rough, per 1,000 ft.	2,500	"
Shingles—per 1,000	250	"
Lath—per 1,000 pieces	500	"
Pickets—Dressed, per 1,000 pieces	1,800	"
" Rough, per 1,000 pieces	2,500	"

WEAR AND TEAR OF BUILDING MATERIALS.

The figures given below are averages deduced from replies made by eighty-three competent builders in twenty-seven cities and towns of Western States:

Material in Buildings.	Frame Dwellings.		Brick Dwellings. (Shingle roof)		Frame Stores.		Brick Stores. (Shingle roof)	
	Average Life, years.	Percentage of Depreciation per Annum.	Average Life, years.	Percentage of Depreciation per Annum.	Average Life, years.	Percentage of Depreciation per Annum.	Average Life, years.	Percentage of Depreciation per Annum.
Brick	..	..	75	1⅛	..	..	66	1½
Plastering	20	5	30	3⅓	16	6	30	3⅓
Painting, outside	5	20	7	14	5	20	6	16
Painting, inside	7	14	7	14	5	20	6	16
Shingles	16	6	16	6	16	6	16	6
Cornice	40	2½	40	2½	30	3⅓	40	2½
Weather-boarding	30	3⅓	..	..	30	3⅓	..	..
Sheathing	50	2	50	2	40	2½	50	2
Flooring	20	5	20	5	13	8	13	8
Doors, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Windows, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Stairs and newel	30	3⅓	30	3⅓	20	5	20	5
Base	40	2½	40	2½	30	3⅓	30	3⅓
Inside blinds	30	3⅓	30	3⅓	30	3⅓	30	3⅓
Building hardware	20	5	20	5	13	8	13	8
Piazzas and porches	20	5	20	5	20	5	20	5
Outside blinds	16	6	16	6	16	6	16	6
Sills and first floor joints	25	4	40	2½	25	4	30	3⅓
Dimension lumber	50	2	75	1⅓	40	2½	66	1½

In Java the "Valley of the Upas Tree" is sometimes called the "Valley of Death," and its deadly influence was formerly ascribed to the malignant properties of a peculiar vegetable production of the island, called the "upas tree," which especially flourishes in this locality. Recent travelers, however, declare that accounts of the fatality attending a passage of this famous valley have been greatly exaggerated.

A man may fish with the worm that hath eat of a king, and eat of the fish that hath fed of that worm.—*Shakespeare.*

HOW TO USE CEMENT.

The following general rules referring to the practical use of cement will be found convenient for reference:

Quality of Sand—The sand should be clean, sharp and coarse. When the sand is mixed with loam the mortar will set comparatively slow, and the work will be comparatively weak. Fine sand, and especially water-worn sand, delays the setting of the cement, and deteriorates strength. Damp sand should not be mixed with dry cement, but the cement and sand should be mixed thoroughly and uniformly together, when both are dry, and no water should be applied until immediately before the mortar is wanted for use.

Proportion of Sand—The larger the proportion of cement the stronger the work. One part of good cement to two parts sand is allowable for ordinary work; but for cisterns, cellars, and work requiring special care, half and half is the better proportion. For floors, the cement should be increased toward the surface.

Water in Concrete—Use no more water in cement than absolutely necessary. Cement requires but a very small quantity of water in crystalizing. Merely dampening the material gives the best results. Any water in excess necessarily evaporates and leaves the hardened cement comparatively weak and porous.

Concrete in Water—Whenever concrete is used under water, care must be taken that the water is still. So say all English and American authorities. In laying cellar floors, or constructing cisterns or similar work, care must also be taken to avoid *pressure of exterior water*. Cement will not crystalize when disturbed by the force of currents, or pressure of water, but will resist currents and pressure after hardening only. In still water, good cement will harden quicker than in air, and when kept in water will be stronger than when kept in air. Cements which harden especially quick in air are usually slow or worthless in water.

How to Put Down Concrete—When strong work is wanted, for cellar floors and all similar work, the concrete should be dampened and tamped down to place, with the back of a spade, or better, with the end of a plank or rammer; then finished off with a trowel, thus leveling and compacting the work. Only persons ignorant of the business will lay a floor or walk with soft cement mortar. All artificial stone is made in a similar way to that described, and, when set, is strong and hard as stone.

Delay in Use—Do not permit the mortar to exhaust its setting properties by delaying its use when ready. Inferior cements only will remain standing in the mortar-bed any length of time without serious injury.

Stone and Brick Work—In buildings constructed of stone or brick, the best protection from dampness and decay, and also from the danger of cyclones, is a mortar of cement and coarse sand. The extra cost is inconsiderable, and the increased value of the structure very great. Chimneys laid in this manner never blow down, and cellars whose foundations are thus laid are always free from atmospheric moisture. Cement may also be mixed with lime mortar for plastering and other purposes, to great advantage.

Effect of Frost and Cold—At a temperature less than 60 degrees Fahrenheit, all good cement sets slowly, though surely, but if allowed to freeze its value is seriously impaired. In cold weather or cold water do not fear to wait for your concrete to crystalize.

Damage from Moisture—Good cement is not injured by age, if carefully preserved from moisture. Lumps in bags or barrels of cement are caused by exposure to moisture. They prove the originally good quality of the cement.

THE Ramphorhyncus, the remains of which have been found in the quarries of Solenhofen, Germany, was a curious intermediate link between birds and reptiles. Its tail, a singular appendage, was long, reptile-like, and dragged upon the ground, while its footprints were bird-like.

JOHN VERRAZANNI, an eminent Florentine navigator, in 1524, landed where the lower extremity of New York City is, and giving the natives some spirituous liquors made many of them drunk. The Indians called the place Manna-ha-ta, or "place of drunkenness," and they were afterwards called Manna-ha-tans.

HINTS FOR ROOFERS.

The average width of a shingle is four inches. Hence, when shingles are laid four in. to the weather each shingle averages 16 sq. in., and 900 are required for a square of roofing (100 sq. ft). If 4½ in. to the weather, 800; 5 in., 720; 5½ in., 655; 6 in., 600. In hip-roofs, where the shingles are cut more or less to fit the roof, 5% should be added to these figures.

One thousand shingles laid four inches to the weather will require five pounds of shingle nails. Six pounds of 4*d* nails will lay 1000 split pine shingles.

A carpenter will carry up and lay on the roof from 1,500 to 2,000 shingles per day, or two squares to two squares and a half of plain gable-roofing.

The pitch of a slated roof should be about one in height to four in length. The usual lap is about 3 in., sometimes 4 in. Each slate should be fastened by two 3*d* slate nails, either of galvanized iron, copper or zinc. On roofs of gas-houses the nails should be of copper or yellow metal.

The sides and bottom edges of roof slates should be trimmed, and the nail-holes punched as near the head as possible. When slates are not of uniform size they should be sorted, and the smallest placed near the ridge.

In a first-class slate roof the top course on ridge, and the slate from two to four feet from gutters, and one foot each way from valleys and hips, should be bedded in elastic cement.

Roof-boards for slate roofs should be covered with one or two thicknesses of tarred felt roofing paper before slates are laid. Dry or rosin-sized felt should not be used on roofs.

Number of Slates per Square.

Size in Inches.	Slates per Square.	Size in Inches.	Slates per Square.	Size in Inches.	Slates per Square.
6 x 12	533	8 x 16	277	12 x 20	141
7 x 12	457	9 x 16	246	14 x 20	121
8 x 12	400	10 x 16	221	11 x 22	137
9 x 12	355	9 x 18	213	12 x 22	126
7 x 14	374	10 x 18	192	14 x 22	108
8 x 14	327	12 x 18	160	12 x 24	114
9 x 14	291	10 x 20	169	14 x 24	98
10 x 14	261	11 x 20	154	16 x 24	86

Number of Shingles Required in a Roof.

To the square foot, it takes 9 if exposed 4 inches; 8 if exposed 4½ inches. and 7 1-5 if exposed 5 inches to the weather.

Find the number of shingles required to cover a roof 38 ft. long and the rafters on each side 14 ft. Shingles exposed 4½ inches.

28×38=1064 (sq. ft.) ×8=8512 shingles. Ans.

To find the length of rafters, giving the roof one-third pitch, take three-fifths of the width of the building. If the building is 30 feet wide, they must be 18 feet long, exclusive of projection.

A tin roof, properly put on, and kept painted, will last thirty

years. It ought not to be painted for the first time until it has been on about thirty days, so as to get the grease off the tin, and all the rosin should be carefully scraped off.

It is sometimes necessary, on buildings where there is much dampness or steam, as stables, blacksmith shops, round-houses, etc., to paint the roof tin one coat on the under side before laying.

Tin roofs should be laid with cleats, and not by driving the nails through the tin itself.

There are two kinds of tin—"bright tin," the coating of which is all tin, that is, the tin proper; and "tern," "leaded," or "roofing" tin, the coating of which is a composition, part tin and part lead. This last is a little cheaper, and will not rust any quicker, but the sulphur in soft coal smoke eats through the "leaded" coating sooner than through the "tinned."

There are two sizes of tin, 10x14 and 14x20, and two grades of thickness—IC light, and IX, heavy. For a steep roof (one-sixth pitch or over) the IC 14x20 tin ("leaded" if high up where little smoke will get to it; "bright" if low down), put on with a standing groove, and with the cross-beams put together with a double lock, makes as good a roof as can be made. For flat roofs IX 10x14 "light" is best, laid with cleats, but the others make good roofs and any of them will last 25 years at least.

NUMBER OF SQUARE FEET A BOX OF ROOFING TIN WILL COVER.—For flat seam roofing, using ½-inch locks, a box of "14x20" size will cover about 192 square feet, and for standing seam, using ⅜-inch locks and turning 1¼ and 1½ inches edges, making 1-inch standing seams, it will lay about 168 square feet.

For flat seam roofing, using ½-inch locks, a box of "28x20" size will cover about 399 square feet, and for standing seam, using ⅜-inch locks and turning 1¼ and 1½ inches edges, making 1-inch standing seams, it will lay about 365 square feet.

Every box of roofing plates (IC or IX "14x20" or "28x20" sizes) contains 112 sheets.

Facts About Gas.

A cubic foot of good gas, from a jet one thirty-third of an inch in diameter and a flame of four inches, will burn 65 minutes.

Internal lights require four cubic feet, and external lights about five cubic feet, per hour. Large or Argand burners will require from six to ten feet.

In distilling 56 pounds of coal, the volume of gas produced in cubic feet, when the distillation was effected in three hours, was 41.3; in seven hours, 37.5; in twenty hours, 33.5; in twenty-five hours, 31.7.

A retort produces about 600 cubic feet of gas in five hours, with a charge of about one and a half cwt. of coal, or 2,800 cubic feet in twenty-four hours.

PAINTING AND GLAZING.

Painters' work is generally estimated by the square yard, and the cost depends on the number of coats applied, quality of work and material to be painted.

One coat, or *priming*, will take, per 100 yards of painting, 20 pounds of lead and 4 gallons of oil. Two-coat work, 40 pounds of lead and 4 gallons of oil. Three-coat, the same quantity as two-coat; so that a fair estimate for 100 yards of three-coat work would be 100 pounds of lead and 16 gallons of oil.

One gallon priming color will cover 50 superficial yards; white zinc, 50 yds.; white paint, 44 yds.; lead color, 50 yds.; black paint, 50 yds.; stone color, 44 yds.; yellow paint, 44 yds.; blue color, 45 yds.; green paint, 45 yds.; bright emerald green, 25 yds.; bronze green, 75 yds.

One pound of paint will cover about 4 superficial yards the first coat, and about 6 each additional coat. One pound of putty, for stopping, every 20 yards. One gallon of tar and 1 lb. of pitch will cover 12 yards superficial the first coat, and 17 yards each additional coat. A square yard of new brick wall requires, for the first coat of paint in oil, ¾ lb.; for the second, 3 lbs.; for the third, 4 lbs.

A day's work on the outside of a building is 100 yards of first coat, and 80 yds. of either second or third coat. An ordinary door, including casings, will, on both sides, make 8 to 10 yds. of painting, or about 5 yds. to a door without the casings. An ordinary window makes about 2½ or 3 yds.

Window Glass is sold by the box, which contains, as nearly as possible, 50 sq. ft., whatever the size of the panes. The thickness of ordinary, or "single thick" window glass is about one-sixteenth of an inch, and of "double thick" nearly ⅛ in. The tensile strength of common glass varies from 2,000 to 3,000 lbs. per sq. in., and its crushing strength from 6,000 to 10,000 lbs.

Where Skylights are glazed with clear or double thick glass, it may be used in lengths of from 16 to 30 in. by a width of from 9 to 15 in. A lap of at least an inch and a half is necessary for all joints. This is the cheapest mode of glazing. The best, however, for skylight purposes is fluted or rough plate glass. The following thicknesses are recommended as proportionate to sizes: 12x48, 3-16 in.; 15x60, ¼ in.; 20x100, ⅜ in.; 94x156, ½ in.

Polished French plate window glass, which is the highest grade of window glass in the market, may be obtained in lights ranging in size from one inch square upwards. Owing to the extra cost of rolling large lights the price of these per square foot is sometimes double that of smaller lights.

Faith is the substance of things hoped for, the evidence of things unseen.—New Testament.

Sizes of Chairs and Desks for Schools.

Desks for Single Scholar, 2 ft. long; For Two Scholars, 3 ft. 10 in.

Age of Scholar.	Height of Chair.	Height of Desk (next scholar).	Space Occupied by Desk and Chair.
16 to 18 years.	16¾ inches.	29½ inches.	2 feet 9 inches.
14 to 16 "	15½ "	28 "	2 " 9 "
12 to 14 "	15½ "	27½ "	2 " 8 "
10 to 12 "	14¼ "	26½ "	2 " 7 "
8 to 10 "	13¼ "	25½ "	2 " 5 "
7 to 8 "	12¼ "	24 "	2 " 4 "
6 to 7 "	11½ "	22½ "	2 " 3 "
5 to 6 "	10½ "	21 "	2 " 2 "
4 to 5 "	9½ "	19 "	2 " 0 "

WEIGHT OF FLOORS, AND THE LOAD UPON SAME.

The dead weight of a fire-proof floor will average for the arches, concrete, plastering and flooring, 70 lbs. per sq. foot. The live weight, equal to a dense crowd of people, 80 lbs. per sq. foot, or a total for an office building of 150 lbs. per sq. foot.

The following loads are exclusive of weight of arches and beams:

Dense crowd of people	80	lbs. per sq. foot
For floors of houses	50	" " " "
Theaters and churches	80	" " " "
Ball rooms	90	" " " "
Ware houses	250	" " " "
Factories	200 to 450	" " " "
Snow 30 inches deep	15	" " " "
Brick walls	112	" " cubic "
Stone (Chicago lime stone, dressed)	160	" " " "

The dead weight of a wooden floor, including wood joists:

Double flooring and plastering will average	25	lbs. per sq. foot
If deafened	35	" " " "
Stud partition of wood plastered each side	20	" " " "

In estimating the weight of a flat ceiling and roof it will be safe to assume the following:

Ceiling of wooden construction	15	lbs per sq. foot.
Ceiling of iron construction	25 to 65	" " " "
Roof of wooden construction	45	" " " "
Roof of iron construction	65 to 100	" " " "

The weight of roof includes the wind pressure and snow.

Strength of Piers.—Granite will sustain 40 tons per sq. ft.; Berea (sand stone), 30 tons per sq. ft.; limestone (magnesium), 29 tons per sq. ft.; Portland (sand stone), 13 tons per sq. ft.; brick in cement, 3 tons per sq. ft.; rubble masonry, 2 tons per sq. ft.; lime, cement foundation, 2½ tons per sq. ft.

WEIGHT OF VARIOUS MATERIALS.

WEIGHT OF STONES.—Granite, (averages) per cubic foot, 170 lbs.; limestone (magnesium), 144 lbs.; Berea (sand stone), 140 lbs.; free stone, 140 lbs.; gypsum, natural state, 140 lbs.

One ton of vein marble is 13 cubic feet; of statuary marble, 13½; granite, 13½; of Berea stone, 14⅓; of limestone, magnesium, 13¾.

WEIGHT OF MASONRY.—Granite, per cubic foot, 160 lbs.; of Berea stone range, 140; of limestone rubble, 140; of brick, dry, 115; of brick, dry (press), 130; of brick, dry (fire), 150; of brick masonry in mortar, 110; of brick masonry cement, 112.

WEIGHT OF MARBLE SLABS.—One-half inch thick, per sq. foot, 7.17 lbs.; ¾ inch thick, 10.75; 1 inch thick, 14.32; 1¼ inch thick, 17.92; 1½ inch thick, 21.05; 1¾ inch thick, 25.08; 2 inch thick, 28.67; 2½ inch thick, 35.83.

CEMENT AND LIME.—One bushel of Portland cement weighs 96 lbs.; of Rosendale, 70; of Louisville, 62; of quick lime well shaken, 80; of quick lime, loose, 70.

IRON AND WOOD.—One cubic foot of wrought iron weighs 480 lbs.; of cast iron, 450; of oak (seasoned), 48; of pine (seasoned), 36.

COAL.—One bushel of Anthracite weighs 86 lbs.; of Bituminous, 80; of coke (Connellsville), 40; of charcoal (hardwood) 30.

MISCELLANEOUS WEIGHTS.—Per cubic foot: Ordinary quick lime, 53 lbs.; old mortar, 90; new mortar, well tempered, 115; new mortar, 110; river sand (average), 107; river sand (screened), 95; clay with gravel, 130; earth—vegetable, 90; earth—loamy, 100; earth—semi fluid, 110.

SAN MARINO, in Italy, on the coast of the Adriatic Sea, is the oldest Republic in the world. It is, next to Monaco, the smallest State in Europe. The exact date of the establishment of this Republic is not known, but according to tradition, it was in the fourth century, by Marinus, a Dalmatian hermit, and has ever since remained independent. It is mountainous, and contains four or five villages. The word "LIBERTY" is inscribed on its capitol.

Is LIFE so dear, or peace so sweet, as to be purchased at the price of chains and slavery? Forbid it, Almighty God! I know not what course others may take; but as for me, give me liberty or give me death!—*Patrick Henry.*

THE law is a sort of hocus-pocus science, that smiles in yer face while it picks yer pocket; and the glorious uncertainty of it is of mair use to the professors than the justice of it.—*Macklin.*

KNOWLEDGE is of two kinds: we know a subject ourselves or we know where we can find information upon it.—*Johnson.*

Crushing and Tensile Strength, in Lbs., per Sq. Inch of Natural and Artificial Stones.

DESCRIPTION.	Weight per Cubic ft. in lbs.	Crushing Force. Lbs. per Square Inch.
Aberdeen Blue Granite	164	8,400 to 10,914
Quincy Granite	166	15,300
Freestone, Belleville	......	3,522
Freestone, Caen	......	1,088
Freestone, Connecticut	......	3,319
Sandstone, Acquia Creek, used for Capitol, Washington	......	5,340
Limestone, Magnesian, Grafton, Ill	......	17,000
Marble, Hastings, N. Y	......	18,941
Marble, Italian	......	12,624
Marble, Stockbridge, City Hall, N. Y	......	10,382
Marble, Statuary	.....	3,216
Marble, Veined	165	9,681
Slate	......	9,300
Brick, Red	135.5	808
Brick, Pale Red	130.3	562
Brick, Common	......	800 to 4,000
Brick, Machine Pressed	......	6,222 to 14,216
Brick, Stock	......	2,177
Brick-work, set in Cement, bricks not very hard	......	521
Brick, Masonry, Common	......	500 to 800
Cement, Portland	......	1,000 to 8,300
Cement, Portland, Cement 1, Sand 1	......	1,280
Cement, Roman	......	342
Mortar	......	120 to 240
Crown Glass	......	31,000
		TENSION.
Portland Cement	......	427 to 711
Portland Cement, with Sand	......	92 to 284
Glass, Plate	......	9,420
Mortar	......	50
Plaster of Paris	......	72
Slate	......	11,000

ERROR of opinion may be tolerated where reason is left free to combat it.—*Thomas Jefferson.*

VIRTUE is like precious odors, most fragrant when they are incensed or crushed.—*Lord Bacon.*

WEIGHT OF CAST IRON COLUMNS.

PER LINEAL FOOT OF PLAIN SHAFT.

Diam.	THICKNESS OF METAL.											
	¼ in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1⅛ in.	1¼ in.	1½ in.	1¾ in.	2 in.
2	4.3	6.0	7.4	8.4	9.2	9.7	9.8	......	......	......	......	......
2½	5.5	7.8	9.8	11.5	12.9	14.0	14.7	......	......	......	......	......
3	6.8	9.7	12.3	14.6	16.6	18.3	19.6	......	......	......	......	......
3½	8.0	11.5	14.7	17.6	20.3	22.6	24.6	......	......	......	......	......
4	9.2	13.3	17.2	20.7	23.9	26.8	29.5	......	......	......	......	......
4½	10.4	15.2	19.6	23.8	27.6	31.1	34.4	37.3	39.9	......	......	......
5	11.7	17.0	22.1	26.9	31.3	35.4	39.3	42.8	46.0	......	......	......
5½	12.9	18.9	24.5	29.9	35.0	39.7	44.2	48.3	52.2	......	......	......
6	14.1	20.7	27.8	33.0	38.7	44.0	49.1	53.9	58.3	......	......	......
6½	15.3	22.6	29.5	36.1	42.3	48.3	54.0	59.4	64.4	......	......	......
7	16.6	24.4	31.9	39.1	46.0	52.6	58.9	64.9	70.6	81.0	......	......
7½	17.8	26.2	34.4	42.2	49.7	56.9	63.8	70.4	76.7	88.4	......	......
8	19.0	28.1	36.8	45.3	53.4	61.2	68.7	75.9	82.8	95.7	......	......
8½	20.2	29.9	39.3	48.3	57.1	65.5	73.6	81.5	89.0	103.1	......	......
9	21.5	31.8	41.7	51.4	60.8	69.8	78.5	87.0	95.1	110.5	......	......
9½	22.7	33.6	44.2	54.5	64.4	74.1	83.5	92.5	101.2	117.8	133.2	......
10	23.9	35.4	46.6	57.5	68.1	78.4	88.4	98.0	107.4	125.2	141.7	157.1
10½	25.2	37.3	49.1	60.6	71.8	82.7	93.3	103.5	113.5	132.5	150.3	166.9
11	26.4	39.1	51.6	63.7	75.5	87.0	98.2	109.1	119.7	139.9	158.9	176.7
11½	27.6	41.0	54.8	66.7	79.2	91.3	103.1	114.6	125.8	147.3	167.5	186.5
12	28.8	42.8	56.5	69.8	82.8	95.6	108.0	120.1	131.9	154.6	176.1	196.3
12½	.....	44.6	58.9	72.9	86.5	99.9	112.9	125.6	138.1	162.0	184.7	206.2
13	.....	46.5	61.4	75.9	90.2	104.2	117.8	131.2	144.2	169.4	193.3	216.0
13½	.....	.....	63.8	79.0	93.9	108.5	122.7	136.7	150.3	176.7	201.9	225.8
14	.....	.....	66.3	82.1	97.6	112.8	127.6	142.2	156.5	184.1	210.5	235.6
14½	.....	.....	68.7	85.2	101.2	117.0	132.5	147.7	162.6	191.4	219.1	245.4
15	.....	.....	71.2	88.2	104.9	121.3	137.5	153.2	168.7	198.8	227.6	255.2
16	.....	.....	76.1	94.3	112.3	129.9	147.3	164.3	181.0	213.5	244.8	274.9
17	.....	.....	81.0	100.5	119.7	138.5	157.1	175.3	193.3	228.3	262.0	294.5
18	.....	.....	85.9	106.6	127.0	147.1	166.9	186.4	205.6	243.0	279.2	314.1
19	.....	.....	90.8	112.8	134.4	155.7	176.7	197.4	217.8	257.7	296.4	333.8
20	.....	.....	95.7	118.9	141.7	164.3	186.5	208.5	230.1	274.4	313.5	353.4

INCREASE IN WEIGHT FOR 1-2 IN. INCREASE IN DIAMETER.

¼ in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1⅛ in.	1¼ in.	1½ in.	1¾ in.	2 in.
1.2	1.8	2.5	3.1	3.7	4.3	4.9	5.5	6.1	7.4	8.6	9.8

WEIGHT OF CAST IRON BALLS.

Diameter, Inches.	Weight, Lbs.	Diameter, Inches.	Weight, Lbs.	Diameter, Inches.	Weight, Lbs.
2	1.09	5	17.04	8	69.81
2½	2.13	5½	22.68	8½	83.73
3	3.68	6	29.45	9	99.40
3½	5.84	6½	37.44	10	136.35
4	8.73	7	46.76	11	181.48
4½	12.42	7½	57.52	12	235.65

To Find the Weight of Cast Iron Balls When the Diameter is Given—*Rule:* Multiply the cube of the diameter by .1377.

To Find the Diameter of Cast Iron Balls When the Weight is Given—*Rule:* Multiply the cube root of the weight by 1.936.

To Find the Weight of a Spherical Shell—From the weight of a ball of the outer diameter subtract the weight of one of the inner diameter.

Cast Iron—Assumed Weight in Estimating

A cubic foot	= 450 lbs.
A square foot, 1 inch thick	= 38 "
A bar 1 inch square and 1 foot long . .	= 3.125 "

TABLE OF WEIGHT PER LINEAL FOOT OF ROUND CAST IRON.

Diameter, Inches.	Weight, Lbs.	Diameter, Inches.	Weight, Lbs.	Diameter, Inches.	Weight, Lbs.
1	2.45	5	61.36	9	198.80
1¼	3.84	5¼	67.65	9½	221.51
1½	5.52	5½	74.25	10	245.44
1¾	7.52	5¾	81.15	10½	270.60
2	9.82	6	88.36	11	296.98
2¼	12.43	6¼	95.87	11½	324.59
2½	15.34	6½	103.70	12	353.43
2¾	18.56	6¾	111.83	13	414.79
3	22.09	7	120.26	14	481.06
3¼	25.92	7¼	129.01	15	552.23
3½	30.07	7½	138.06	16	628.32
3¾	34.52	7¾	147.42	17	709.31
4	39.27	8	157.08	18	795.22
4¼	44.33	8¼	167.05	20	981.75
4½	49.70	8½	177.33	22	1187.92
4¾	55.38	8¾	187.91	24	1413.72

AREAS OF CIRCLES,

Advancing by eighths.

Diam.	0	⅛	¼	⅜	½	⅝	¾	⅞
0	.0	.0122	.0490	.1104	.1963	.3068	.4417	.6013
1	.7854	.9940	1.227	1.484	1.767	2.073	2.405	2.761
2	3.1416	3.546	3.976	4.430	4.908	5.411	5.939	64.91
3	7.068	7.669	8.295	8.946	9.621	10.32	11.04	11.79
4	12.56	13.36	14.18	15.03	15.90	16.80	17.72	18.66
5	19.63	20.62	21.64	22.69	23.75	24.85	25.96	27.10
6	28.27	29.46	30.67	31.91	33.18	34.47	35.78	37.12
7	38.48	39.87	41.28	42.71	44.17	45.66	47.17	48.70
8	50.26	51.84	53.45	55.08	56.74	58.42	60.13	61.86
9	63.61	65.39	67.20	69.02	70.88	72.75	74.69	76.58
10	78.54	80.51	82.51	84.54	86.59	88 66	90.76	92.88
11	95.03	97.20	99.40	101.6	103.8	106.1	108.4	110.7
12	113.0	115.4	117.8	120.2	122.7	125.1	127.6	130.1
13	132.7	135.2	137.8	140.5	143.1	145.8	148.4	151.2
14	153.9	156.6	159.4	162.2	165.1	167.9	170.8	173 7
15	176.7	179 6	182.6	185.6	188.6	191.7	194.8	197.9
16	201.0	204.2	207.3	210.5	213.8	217.0	220.3	223.6
17	226.9	230.3	233.7	237.1	240.5	243.9	247.4	250.9
18	254.4	258.0	261.5	265.1	268.8	272.4	276.1	279.8
19	283.5	287.2	291.0	294 8	298.8	302.4	306.3	310.2
20	314.1	318.1	322.0	326.0	330.0	334.1	338.1	342.2
21	346.3	350.4	354.6	358.8	363.0	367.2	371.5	375.8
22	380.1	384.4	388.8	393.2	397.6	402.0	406.4	410.9
23	415.4	420.0	424.5	429.1	433.7	438.3	443.0	447.6
24	452.3	457.1	461.8	466.6	471.4	476.2	481.1	485.9
25	490.8	495.7	500.7	505.7	510.7	515.7	520.7	525.8
26	530.9	536.0	541.1	546.3	551.5	556.7	562.0	567.2
27	572.5	577.8	583.2	588.5	593.9	599.3	604.8	610.2
28	615.7	621.2	626.7	632.3	637.9	643.5	649.1	654.8
29	660.5	666.2	671.9	677.7	683.4	689.2	695.1	700.9
30	706.8	712.7	718.6	724.6	730.6	736.6	742.6	748.6
31	754.8	760.9	767.0	773.1	779.3	785.5	791.7	798.0
32	804.3	810.6	816.9	823.2	829.6	836.0	842.4	848.8
33	855.3	861.8	868.3	874.9	881.4	888.0	894.6	901.3
34	907.9	914.7	921.3	928.1	934.8	941.6	948.4	955.3
35	962.1	969.0	975.9	982.8	989.8	996.8	1003.8	1010.8
36	1017.9	1025.0	1032.1	1039.2	1046.3	1053.5	1060.7	1068.0
37	1075.2	1082.5	1089.8	1097.1	1104.5	1111.8	1119.2	1126.7
38	1134.1	1141.6	1149.1	1156.6	1164.2	1171.7	1179.3	1186.9
39	1194.6	1202.3	1210.0	1217.7	1225.4	1233.2	1241.0	1248.8
40	1256.6	1264.5	1272.4	1280.3	1288.2	1296.2	1304.2	1312.2
41	1320.3	1328.3	1336.4	1344.5	1352.7	1360.8	1369.0	1377.2
42	1385.4	1393.7	1402.0	1410.3	1418.6	1427.0	1435.4	1443.8
43	1452.2	1460.7	1469.1	1477.6	1486.2	1494.7	1503.3	1511.9
44	1520.5	1529.2	1537.9	1546.6	1555.3	1564.0	1572.8	1581.6
45	1590.4	1599.3	1608.2	1617.0	1626.0	1634.9	1643.9	1652.9

CIRCUMFERENCES OF CIRCLES,

Advancing by eighths.

Diam	CIRCUMFERENCES.							
	0	⅛	¼	⅜	½	⅝	¾	⅞
0	.0	.3927	.7854	1.178	1.570	1.963	2.356	2.748
1	3.141	3.534	3.927	4.319	4.712	5.105	5.497	5.890
2	6.283	6.675	7.068	7.461	7.854	8.246	8.639	9.032
3	9.424	9.817	10.21	10.60	10.99	11.38	11.78	12.17
4	12.56	12.95	13.35	13.74	14.13	14.52	14.92	15.31
5	15.70	16.10	16.49	16.88	17.27	17.67	18.06	18.45
6	18.84	19.24	19.63	20.02	20.42	20.81	21.20	21.59
7	21.99	22.38	22.77	23.16	23.56	23.95	24.34	24.74
8	25.13	25.52	25.91	26.31	26.70	27.09	27.48	27.88
9	28.27	28.66	29.05	29.45	29.84	30.23	30.63	31.02
10	31.41	31.80	32.20	32.59	32.98	33.37	33.77	34.16
11	34.55	34.95	35.34	35.73	36.12	36.52	36.91	37.30
12	37.69	38.09	38.48	38.87	39.27	39.66	40.05	40.44
13	40.84	41.23	41.62	42.01	42.41	42.80	43.19	43.58
14	43.98	44.37	44.76	45.16	45.55	45.94	46.33	46.73
15	47.12	47.51	47.90	48.30	48.69	49.08	49.48	49.87
16	50.26	50.65	51.05	51.44	51.83	52.22	52.62	53.01
17	53.40	53.79	54.19	54.58	54.97	55.37	55.76	56.15
18	56.54	56.94	57.33	57.72	58.11	58.51	58.90	59.29
19	59.69	60.08	60.47	60.86	61.26	61.65	62.04	62.43
20	62.83	63.22	63.61	64.01	64.40	64.79	65.18	65.58
21	65.97	66.36	66.75	67.15	67.54	67.93	68.32	68.72
22	69.11	69.50	69.90	70.29	70.68	71.07	71.47	71.86
23	72.25	72.64	73.04	73.43	73.82	74.22	74.61	75.00
24	75.39	75.79	76.18	76.57	76.96	77.36	77.75	78.14
25	78.54	78.93	79.32	79.71	80.10	80.50	80.89	81.28
26	81.68	82.07	82.46	82.85	83.25	83.64	84.03	84.43
27	84.82	85.21	85.60	86.00	86.39	86.78	87.17	87.57
28	87.96	88.35	88.75	89.14	89.53	89.92	90.32	90.71
29	91.10	91.49	91.89	92.28	92.67	93.06	93.46	93.85
30	94.24	94.64	95.03	95.42	95.81	96.21	96.60	96.99
31	97.39	97.78	98.17	98.57	98.96	99.35	99.75	100.14
32	100.53	100.92	101.32	101.71	102.10	102.49	102.89	103.29
33	103.67	104.07	104.46	104.85	105.24	105.64	106.03	106.42
34	106.81	107.21	107.60	107.99	108.39	108.78	109.17	109.56
35	109.96	110.35	110.74	111.13	111.53	111.92	112.31	112.71
36	113.10	113.49	113.88	114.28	114.67	115.06	115.45	115.85
37	116.24	116.63	117.02	117.42	117.81	118 20	118.61	118.99
38	119.38	119.77	120.17	120.56	120.95	121.34	121.74	122.13
39	122.52	122.92	123.31	123.70	124.09	124.49	124.88	125.27
40	125.66	126.06	126.45	126.84	127.24	127.63	128.02	128.41
41	128.81	129.20	127.59	129.98	130.38	130.77	131.16	131.55
42	131.95	132.34	132.73	133.13	133.52	133.91	134.30	134.70
43	135.09	135.48	135.87	136.27	136.66	137.05	137.45	137.84
44	138.23	138.62	139.02	139.41	139.80	140.19	140.59	140.98
45	141.37	141.76	142.16	142.55	142.94	143.34	143.73	144.12

Table of Decimal Equivalents of 8ths, 16ths, 32nds and 64ths of an Inch.

8ths.

$\frac{1}{8}$ =	.125
$\frac{1}{4}$ =	.250
$\frac{3}{8}$ =	.375
$\frac{1}{2}$ =	.500
$\frac{5}{8}$ =	.625
$\frac{3}{4}$ =	.750
$\frac{7}{8}$ =	.875

16ths.

$\frac{1}{16}$ =	.0625
$\frac{3}{16}$ =	.1875
$\frac{5}{16}$ =	.3125
$\frac{7}{16}$ =	4375
$\frac{9}{16}$ =	.5625
$\frac{11}{16}$ =	6875
$\frac{13}{16}$ =	.8125
$\frac{15}{16}$ =	.9375

32nds.

$\frac{1}{32}$ =	.03125
$\frac{3}{32}$ =	.09375
$\frac{5}{32}$ =	.15625
$\frac{7}{32}$ =	.21875
$\frac{9}{32}$ =	.28125
$\frac{11}{32}$ =	.34375
$\frac{13}{32}$ =	.40625
$\frac{15}{32}$ =	.46875
$\frac{17}{32}$ =	.53125
$\frac{19}{32}$ =	.59375
$\frac{21}{32}$ =	.65625
$\frac{23}{32}$ =	.71875
$\frac{25}{32}$ =	.78125
$\frac{27}{32}$ =	.84375
$\frac{29}{32}$ =	.90625
$\frac{31}{32}$ =	.96875

64ths.

$\frac{1}{64}$ =	.015625
$\frac{3}{64}$ =	.046875
$\frac{5}{64}$ =	.078125
$\frac{7}{64}$ =	.109375
$\frac{9}{64}$ =	.140625
$\frac{11}{64}$ =	.171875
$\frac{13}{64}$ =	.203125
$\frac{15}{64}$ =	.234375
$\frac{17}{64}$ =	.265625
$\frac{19}{64}$ =	.296875
$\frac{21}{64}$ =	.328125
$\frac{23}{64}$ =	.359375
$\frac{25}{64}$ =	.390625
$\frac{27}{64}$ =	.421875
$\frac{29}{64}$ =	.453125
$\frac{31}{64}$ =	.484375
$\frac{33}{64}$ =	.515625
$\frac{35}{64}$ =	.546875
$\frac{37}{64}$ =	.578125
$\frac{39}{64}$ =	.609375
$\frac{41}{64}$ =	.640625
$\frac{43}{64}$ =	.671875
$\frac{45}{64}$ =	.703125
$\frac{47}{64}$ =	.734375
$\frac{49}{64}$ =	.765625
$\frac{51}{64}$ =	.796875
$\frac{53}{64}$ =	.828125
$\frac{55}{64}$ =	.859375
$\frac{57}{64}$ =	.890625
$\frac{59}{64}$ =	.921875
$\frac{61}{64}$ =	.953125
$\frac{63}{64}$ =	.984375

Handy Facts for Architects and Builders.

Pitch of tin, copper or tar-and-gravel roofs five-eighths of an inch to the foot and upwards.

The average weight of 20,000 men and women weighed at Boston was: Men, 141½ lbs.; women, 124½ lbs.

Smallest convenient size of slab for a 14-in. wash bowl, 21 by 24 in. Height of slab from floor, 2 ft. 6 in.

Urinals should be 2 ft. 2 in. between partitions; partitions 6 ft. high.

Space occupied by water-closets, 2 ft. 6 in. wide; 2 ft. deep.

Dimensions of double bed, 6 ft. 6 in. by 4 ft. 6 in.

Dimensions of single bed (in dormitories), 2 ft 8 in. by 6 ft. 6 in.

Dimensions of a bureau, 3 ft. 2 in. wide, 1 ft. 6 in. deep, and upwards.

Dimensions of a common wash-stand, 2 ft. 4 in. wide, 1 ft. 6 in. deep.

Dimensions of a barrel—Diameter of head, 17 in.; bung, 19 in.; length, 28 in.; volume, 7,680 cubic in.

Dimensions of billiard tables (Collender)—4 ft. by 8 ft.; 4 ft. 2 in. by 9 ft.; and 5 ft. by 10 ft. Size of room required respectively, 13 by 17; 14 by 18; 15 by 20.

Horse-stalls—Width, 3 ft. 10 in. to 4 ft., or else 5 ft. or over in width—nine feet long. Width should never be between 4 and 5 ft., as in that case the horse is liable to cast himself.

HORSE POWER OF STEAM ENGINES, ETC.

The *unit* of nominal power for steam engines, or the usual estimate of dynamical effect per minute of a horse, called by engineers a "horse power," is 33,000 pounds at a velocity of 1 foot per minute, or, the effect of a load of 200 pounds raised by a horse for 8 hours a day, at the rate of 2½ miles per hour, or 150 pounds at the rate of 220 feet per minute.

RULE.—Multiply the area of the piston in square inches by the average force of the steam in pounds and by the velocity of the piston in feet per minute; divide the product by 33,000, and $\frac{7}{10}$ of the quotient equal the effective power.

ANOTHER RULE.—The diameter of the piston in inches, multiplied by itself, multiplied by the stroke in inches, multiplied by the revolutions per minute (not the strokes), multiplied by the mean effective (average pressure per square inch on piston), multiplied by .00000397, gives the gross or indicated horse power.

For the net effective horse power, deduct from the above about ¼ for friction of the working parts.

The mean effective pressure can be accurately determined only by the aid of an indicator. When the indicator is not used, and in the calculation the boiler pressure is substituted for the mean effective pressure, deduct from the result obtained from 40 to 60 per cent. for loss by condensation and friction of steam pipes and passages, decrease of pressure in cylinder due to expansion, back pressure of exhaust, and friction of the working parts.

For engines from 20 to 60 horse power, an average of 50 per cent. may be deducted; for smaller engines, more.

The mean pressure in the cylinder when cutting off at

¼	stroke	equals	boiler	pressure	multiplied	by	.597
⅓	"	"	"	"	"	"	.670
⅜	"	"	"	"	"	"	.743
½	"	"	"	"	"	"	.847
⅝	"	"	"	"	"	"	.919
⅔	"	"	"	"	"	"	.937
¾	"	"	"	"	"	"	.966
⅞	"	"	"	"	"	"	.992

Best designed boilers, well set, with good draft and skillful firing, will evaporate from 7 to 10 lbs. of water per pound of first-

class coal. The average result is from 30 to 60 per cent. below this.

In calculating horse power of Tubular or Flue boilers, consider 15 square feet of heating surface equivalent to one *nominal* horse power.

One square foot of grate will consume on an average 12 lbs of coal per hour.

Steam engines, in economy, vary from 30 to 60 lbs. of feed water and from 2 to 7 lbs. of coal per hour per indicated H. P.

HORSE POWER OF BELTING.

A simple rule for ascertaining transmitting power of belting without first computing speed per minute that it travels, is as follows: Multiply diameter of pulley in inches by its number of revolutions per minute, and this product by width of the belt in inches; divide the product by 3,300 for single belting, or by 2,100 for double belting, and the quotient will be the amount of horse power that can be safely transmitted.

Table for Single Leather, Four Ply Rubber and Four Ply Cotton Belting, Belts not Overloaded.

1 INCH WIDE, 800 FEET PER MINUTE=1 HORSE POWER.

Speed in Ft per Min.	WIDTH OF BELTS IN INCHES.											
	2	3	4	5	6	8	10	12	14	16	18	20
	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.	H. P.
400	1	1½	2	2½	3	4	5	6	7	8	9	10
600	1½	2¼	3	3¾	4½	6	7½	9	10½	12	13½	15
800	2½	3	4	5	6	8	10	12	14	16	18	20
1000	2	3¾	5	6¼	7½	10	12½	15	17½	20	22½	25
1200	3	4½	6	7½	9	12	15	18	21	24	27	30
1500	3¾	5¾	7½	9½	11½	15	18¾	22½	26½	30	33¾	37½
1800	4½	6¾	9	11¼	13½	18	22½	27	31½	36	40½	45
2000	5	7½	10	12½	15	20	25	30	35	40	45	50
2400	6	9	12	15	18	24	30	36	42	48	54	60
2800	7	10½	14	17½	21	28	35	42	49	56	63	70
3000	7½	11¼	15	18¾	22½	30	37½	45	52½	60	67½	75
3500	8¾	13	17½	22	26	35	44	52½	61	70	79	88
4000	10	15	20	25	30	40	50	60	70	80	90	100
4500	11¼	17	22½	28	34	45	57	69	78	90	102	114
5000	12½	19	25	31	37½	50	62½	75	87½	100	112	125

Double leather, six-ply rubber or six-ply cotton belting will transmit 50 to 75 per cent. more power than is shown in this table. (One inch wide, 550 feet per minute=one horse power.)

BOILER CHIMNEYS.

For marine boilers the general rule is to allow 14 sq. in. of chimney for each nominal horse-power. For stationary boilers the area of the chimneys should be one-fifth greater than the combined area of all the flues or tubes. Where boilers are provided with other means of draught the dimensions of the chimney are not so important.

Diameter and Height of Boiler Chimneys.

Horse pow'r of Boiler.	Height of Chimney.	Interior Diam. at Top.	Horse pow'r of Boiler.	Height of Chimney.	Interior Diam. at Top.
10	60 ft.	14 inches.	70	120 ft.	30 inches.
12	75 "	14 "	90	120 "	34 "
16	90 "	16 "	120	135 "	38 "
20	99 "	17 "	160	150 "	43 "
30	105 "	21 "	200	165 "	47 "
50	120 "	26 "	250	180 "	42 "
60	120 "	27 "	380	195 "	57 "

Table of the Principal Alloys.

A combination of copper and tin makes bath metal.

A combination of copper and zinc makes bell metal.

A combination of tin and copper makes bronze metal.

A combination of tin, antimony, copper and bismuth makes britannia metal.

A combination of tin and copper makes cannon metal.

A combination of copper and zinc makes Dutch gold.

A combination of copper, nickel and zinc, with sometimes a little iron and tin makes German silver.

A combination of gold and copper makes standard gold.

A combination of gold, copper and silver makes old-standard gold.

A combination of tin and copper makes gun metal.

A combination of copper and zinc makes mosaic gold.

A combination of tin and lead makes pewter.

A combination of lead and a little arsenic makes sheet metal.

A combination of silver and copper makes standard silver.

A combination of tin and lead makes solder.

A combination of lead and antimony makes type metal.

A combination of copper and arsenic makes white copper.

How to Mix Printing Inks and Paints in the Preparation of Tints.

THE FIRST NAMED COLOR ALWAYS PREDOMINATES.

Mixing dark green and purple makes bottle green.

Mixing white and medium yellow makes buff tint.

Mixing red, black and blue makes dark brown.

Mixing bronze, blue, lemon yellow and black makes dark green.

Mixing white, medium yellow and black makes drab tint.

Mixing white, lake and lemon yellow makes flesh tint.

Mixing lemon yellow and bronze blue makes grass-green.
Mixing white and black makes gray tint.
Mixing white and purple makes lavender tint.
Mixing red, black and medium yellow makes maroon.
Mixing lake and purple makes magenta.
Mixing medium yellow and purple makes olive green.
Mixing medium yellow and red makes orange.
Mixing white, ultramarine blue and black makes pearl tint.
Mixing white and lake makes pink.
Mixing ultramarine blue and lake makes purple.
Mixing orange, lake and purple makes russet.
Mixing medium yellow, red and white makes sienna.
Mixing white and ultramarine blue makes sky blue.
Mixing ultramarine blue, black and white makes slate.
Mixing vermillion and black makes Turkey red.
Mixing white, yellow, red and black makes umber.

Durability of Different Woods.

Experiments have been lately made by driving sticks, made of different woods, each two feet long and one and one-half inches square, into the ground, only one-half an inch projecting outward. It was found that in five years all those made of oak, elm, ash, fir, soft mahogany, and nearly every variety of pine, were totally rotten. Larch, hard pine and teak wood were decayed on the outside only, while acacia, with the exception of being also slightly attacked on the exterior, was otherwise sound. Hard mahogany and cedar of Lebanon were in tolerably good condition; but only Virginia cedar was found as good as when put in the ground. This is of some importance to builders, showing what woods should be avoided, and what others used by preference in underground work.

The duration of wood when kept dry is very great, as beams still exist which are known to be nearly 1,100 years old. Piles driven by the Romans prior to the Christian era have been examined of late, and found to be perfectly sound after an immersion of nearly 2,000 years.

The wood of some tools will last longer than the metals, as in spades, hoes and plows. In other tools the wood is first gone, as in wagons, wheelbarrows and machines. Such wood should be painted or oiled; the paint not only looks well, but preserves the wood; petroleum oil is as good as any other.

Hard wood stumps decay in five or six years; spruce stumps decay in about the same time; hemlock stumps in eight to nine years; cedar, eight to nine years; pine stumps, never.

Cedar, oak, yellow pine and chestnut are the most durable woods in dry places.

Timber intended for posts is rendered almost proof against rot by thorough seasoning, charring and immersion in hot coal tar.

Specific Gravity of Various Substances.

A gallon of water or wine weighs 10 lbs., and this is taken as the basis of the following table:

LIQUIDS.		TIMBER.		METALS.	
Water	100	Cork	24	Zinc	719
Sea water	103	Poplar	38	Cast iron	721
Dead Sea	124	Fir	55	Tin	729
Alcohol	84	Cedar	61	Bar iron	779
Olive oil	92	Pear	66	Steel	783
Turpentine	99	Walnut	67	Copper	869
Wine	100	Cherry	72	Brass	840
Urine	101	Maple	75	Silver	1,051
Cider	102	Apple	79	Lead	1,135
Beer	102	Ash	84	Mercury	1,357
Woman's milk	102	Beech	85	Gold	1,926
Cow's "	103	Mahogany	106	Platina	1,950
Goat's "	104	Oak	117		
Porter	104	Ebony	133		

PRECIOUS STONES.

Emerald	277.5	Diamond	353.0	Garnet	406.3
Crystal	265.3	Topaz	401.1	Ruby	428.3

SUNDRIES.

Indigo	77	Peat	133	Porcelain	226
Gunpowder	93	Opium	134	Stone	252
Butter	94	Honey	145	Marble	270
Ice	117	Ivory	183	Granite	278
Clay	120	Brick	200	Chalk	279
Coal	130	Sulphur	203	Glass	289

Weight in Cubic Feet.

	Lbs. per Cub. Ft.		Lbs. per Cub. Ft.
Cork	15	Brick	120
Cedar	36	Stone	150
Beech	51	Granite	166
Butter	56	Glass	172
Water	62	Iron	470
Mahogany	66	Copper	520
Ice	70	Silver	630
Oak	70	Lead	680
Clay	72	Gold	1,155
Coal	80		

Tensile and Transverse Strength

A crushing force of 1,000 lbs. per square inch on a bar 1 inch square, and 12 inches long, gives the following ratios of strength:

	Tensile.	Transverse.		Tensile.	Transverse.
Stone	100	10	Cast iron	158	20
Glass	123	10	Timber	1,900	85

Tensile Test of Steel.

BAR 8 INCHES LONG.

Sq. Inch Section.	Strain, Tons per Sq. Inch.	Extension, Inches.	Sq. Inch Section.	Strain, Tons per Sq. Inch.	Extension, Inches.
1.0000	13.93	.01	.8325	28.35	1.40
.9799	16.96	.10	.7088	27.32	2.00
.9331	23.43	.40	.5541	25.05	2.20
.8741	27.23	1.00			

Elastic Limit	17.40 tons.	Cohesion	45.21 tons.
Maximum strain	28.35 "	Extension	27½ per cent.
Breaking load	25.05 "	Contraction	44½ "

Taking the strength of Swedish iron at 100, the tensile strength of steel compares thus:

Swedish iron	100	Cannon steel	173
Boiler steel	118	Spring steel	202

Pecuniary Value of Metals.

Few people have any idea of the value of precious metals other than gold, silver and copper, which are commonly supposed to be the most precious of all. There are many metals more valuable and infinitely rarer. The following table gives the names and prices of all the known metals of pecuniary worth:

	Price per Av. pound.		Price per Av. pound.
Vanadium	$10,000 00	Gold	$ 330 00
Rubidium	9,070 00	Molybdenum	225 00
Zirconium	7,200 00	Thallium	225 00
Lithium	7,000 00	Platinum	150 00
Glucium	5,400 00	Manganese	130 00
Calcium	4,500 00	Tungstein	115 00
Strontium	4,200 00	Magnesium	64 00
Terbium	4,080 00	Potassium	64 00
Vitrium	4,080 00	Aluminum	32 00
Erbium	3,400 00	Silver	20 00
Cerium	3,400 00	Cobalt	16 00
Didymium	3,200 00	Sodium	8 00
Indium	3,200 00	Nickel	5 00
Ruthenium	2,400 00	Cadmium	4 00
Rhodium	2,300 00	Bismuth	2 50
Niobium	2,300 00	Mercury	95
Barium	1,800 00	Arsenic	50
Palladium	1,400 00	Tin	25
Osmium	1,300 00	Copper	25
Iridium	1,090 00	Antimony	16
Uranium	900 00	Zinc	11
Titanium	689 00	Lead	08
Chromium	500 00		

VALUE OF METALS AS CONDUCTORS.

	Heat.	Electricity.		Heat.	Electricity.
Gold	100	94	Iron	37	16
Platinum	98	16	Zinc	36	29
Silver	97	74	Tin	30	15
Copper	90	100	Lead	18	8

TENACITY OF METALS.

A wire, 0.84 of a line in diameter, will sustain weights as follows:

Lead	28 lbs.	Silver	187 lbs.
Tin	35 "	Platinum	274 "
Zinc	110 "	Copper	302 "
Gold	150 "	Iron	549 "

FLUID DENSITY OF METALS.

Zinc	6.48	Copper	8.22
Iron	6.88	Silver	9.51
Tin	7.03	Lead	10.37

TABLE OF SQUARES AND CUBES

OF

ALL NUMBERS FROM 1 TO 500.

No.	Squares.	Cubes.	No.	Squares.	Cubes.
1	1	1	55	30 25	166 375
2	4	8	56	31 36	175 616
3	9	27	57	32 49	185 193
4	16	64	58	33 64	195 112
5	25	1 25	59	34 81	205 379
6	36	2 16	60	36 00	216 000
7	49	3 43	61	37 21	226 981
8	64	5 12	62	38 44	238 328
9	81	7 29	63	39 69	250 047
10	1 00	1 000	64	40 96	262 144
11	1 21	1 331	65	42 25	274 626
12	1 44	1 728	66	43 56	287 496
13	1 69	2 197	67	44 89	300 763
14	1 96	2 744	68	46 24	314 432
15	2 25	3 375	69	47 61	328 509
16	2 56	4 096	70	49 00	343 000
17	2 89	4 913	71	50 41	357 911
18	3 24	5 832	72	51 84	373 248
19	3 61	6 859	73	53 29	389 017
20	4 00	8 000	74	54 76	405 224
21	4 41	9 261	75	56 25	421 875
22	4 84	10 648	76	57 76	438 976
23	5 29	12 167	77	59 29	456 533
24	5 76	13 824	78	60 84	474 552
25	6 25	15 625	79	62 41	493 039
26	6 76	17 576	80	64 00	512 000
27	7 29	19 683	81	65 81	531 441
28	7 84	21 952	82	67 24	551 368
29	8 41	24 389	83	68 89	571 787
30	9 00	27 000	84	70 56	592 704
31	9 61	29 791	85	72 25	614 125
32	10 24	32 768	86	73 96	636 056
33	10 89	35 937	87	75 69	658 503
34	11 56	39 304	88	77 44	681 472
35	12 25	42 875	89	79 21	704 969
36	12 96	46 656	90	81 00	729 000
37	13 69	50 653	91	82 81	753 571
38	14 44	54 872	92	84 64	778 688
39	15 21	59 319	93	86 49	804 357
40	16 00	64 000	94	88 36	830 584
41	16 81	68 921	95	90 25	857 375
42	17 64	74 088	96	92 16	884 736
43	18 49	79 507	97	94 09	912 673
44	19 36	85 184	98	96 04	941 192
45	20 25	91 125	99	98 01	970 299
46	21 16	97 336	100	1 00 00	1 000 000
47	22 09	103 823	101	1 02 01	1 030 301
48	23 04	110 592	102	1 04 04	1 061 298
49	24 01	117 649	103	1 06 09	1 092 727
50	25 00	125 000	104	1 08 16	1 124 864
51	26 01	132 651	105	1 10 25	1 157 625
52	27 04	140 608	106	1 12 36	1 191 016
53	28 09	148 877	107	1 14 49	1 225 043
54	29 16	157 464	108	1 16 64	1 259 712

No.	Squares.	Cubes.	No.	Squares.	Cubes.
109	1 18 81	1 295 029	169	2 85 61	4 826 809
110	1 21 00	1 331 000	170	2 89 00	4 913 000
111	1 23 21	1 367 631	171	2 92 41	5 000 211
112	1 25 44	1 404 928	172	2 95 84	5 088 448
113	1 27 69	1 442 897	173	2 99 29	5 177 717
114	1 29 96	1 481 544	174	3 02 76	5 268 024
115	1 32 25	1 520 875	175	3 06 25	5 359 375
116	1 34 56	1 560 896	176	3 09 76	5 451 776
117	1 36 89	1 601 613	177	3 13 29	5 545 233
118	1 39 24	1 643 032	178	3 16 84	5 639 752
119	1 41 61	1 685 159	179	3 20 41	5 735 339
120	1 44 00	1 728 000	180	3 24 00	5 832 000
121	1 46 41	1 771 561	181	3 27 61	5 929 741
122	1 48 84	1 815 848	182	3 31 24	6 028 568
123	1 51 29	1 860 867	183	3 34 89	6 128 487
124	1 53 76	1 906 624	184	3 38 56	6 229 504
125	1 56 25	1 953 125	185	3 42 25	6 331 625
126	1 58 76	2 000 376	186	3 45 96	6 434 856
127	1 61 29	2 048 383	187	3 49 69	6 539 203
128	1 63 84	2 097 152	188	3 53 44	6 644 672
129	1 66 41	2 146 689	189	3 57 21	6 751 269
130	1 69 00	2 197 000	190	3 61 00	6 859 000
131	1 71 61	2 248 091	191	3 64 81	6 967 871
132	1 74 24	2 299 968	192	3 68 64	7 077 888
133	1 76 89	2 352 637	193	3 72 49	7 189 057
134	1 79 56	2 406 104	194	3 76 36	7 301 384
135	1 82 25	2 460 375	195	3 80 25	7 414 875
136	1 84 96	2 515 456	196	3 84 16	7 529 536
137	1 87 69	2 571 353	197	3 88 09	7 645 373
138	1 90 44	2 628 072	198	3 92 04	7 762 392
139	1 93 21	2 685 619	199	3 96 01	7 880 599
140	1 96 00	2 744 000	200	4 00 00	8 000 000
141	1 98 81	2 803 221	201	4 04 01	8 120 601
142	2 01 64	2 863 288	202	4 08 04	8 242 408
143	2 04 49	2 924 207	203	4 12 09	8 365 427
144	2 07 36	2 985 984	204	4 16 16	8 489 664
145	2 10 25	3 048 625	205	4 20 35	8 615 125
146	2 13 16	3 112 136	206	4 24 36	8 741 816
147	2 16 09	3 176 523	207	4 28 49	8 869 743
148	2 19 04	3 241 792	208	4 32 64	8 998 912
149	2 22 01	3 307 949	209	4 36 81	9 129 329
150	2 25 00	3 375 000	210	4 41 00	9 261 000
151	2 28 01	3 442 951	211	4 45 21	9 393 931
152	2 31 04	3 511 808	212	4 49 44	9 528 128
153	2 34 09	3 581 577	213	4 53 69	9 663 597
154	2 37 16	3 652 264	214	4 57 96	9 800 344
155	2 40 25	3 723 875	215	4 62 25	9 938 375
156	2 43 36	3 796 416	216	4 66 56	10 077 646
157	2 46 49	3 869 893	217	4 70 89	10 218 313
158	2 49 64	3 944 312	218	4 75 24	10 360 232
159	2 52 81	4 019 679	219	4 79 61	10 503 459
160	2 56 00	4 096 000	220	4 84 00	10 648 000
161	2 59 21	4 173 281	221	4 88 41	10 793 861
162	2 62 44	4 251 528	222	4 92 84	10 941 048
163	2 65 69	4 330 747	223	4 97 29	11 089 567
164	2 68 96	4 410 944	224	5 01 76	11 239 424
165	2 72 25	4 492 125	225	5 06 25	11 390 625
166	2 75 56	4 574-296	226	5 10 76	11 543 176
167	2 78 89	4 657 463	227	5 15 29	11 697 083
168	2 82 24	4 741 632	228	5 19 84	11 852 352

TABLE OF SQUARES AND CUBES—*Continued.*

No.	Squares.	Cubes.	No.	Squares.	Cubes.
229	5 24 41	12 008 989	289	8 35 21	24 137 569
230	5 29 00	12 167 000	290	8 41 00	24 389 000
231	5 33 61	12 326 391	291	8 46 81	24 642 171
232	5 38 24	12 487 168	292	8 52 64	24 897 088
233	5 42 89	12 649 337	293	8 58 49	25 153 757
234	5 47 56	12 812 904	294	8 64 36	25 412 184
235	5 52 25	12 977 875	295	8 70 25	25 672 375
236	5 56 96	13 144 256	296	8 76 16	25 934 336
237	5 61 69	13 312 053	297	8 82 09	26 198 073
238	5 66 44	13 481 272	298	8 88 04	26 463 592
239	5 71 21	13 651 919	299	8 94 01	26 730 899
240	5 76 00	13 824 000	300	9 00 00	27 000 000
241	5 80 81	13 997 521	301	9 06 01	27 270 901
242	5 85 64	14 172 488	302	9 12 04	27 543 608
213	5 90 49	14 348 907	303	9 18 09	27 818 127
244	5 95 36	14 526 784	304	9 24 16	28 094 464
245	6 00 25	14 706 125	305	9 30 25	28 372 625
246	6 05 16	14 886 936	306	9 36 36	28 652 616
247	6 10 09	15 069 223	307	9 42 49	28 934 443
248	6 15 04	15 252 992	308	9 48 64	29 218 112
249	6 20 01	15 438 249	309	9 54 81	29 503 629
250	6 25 05	15 625 000	310	9 61 00	29 791 000
251	6 30 01	15 813 251	311	9 67 21	30 080 231
252	6 35 04	16 003 008	312	9 73 44	30 371 328
253	6 40 09	16 194 277	313	9 79 69	30 664 297
254	6 45 16	16 387 064	314	9 85 96	30 959 144
255	6 50 25	16 581 375	315	8 92 25	31 255 875
256	6 55 36	16 777 216	316	9 98 56	31 554 496
257	6 60 49	16 974 593	317	10 04 89	31 855 013
258	6 65 64	17 173 512	318	10 11 24	32 157 432
259	6 70 81	17 373 979	319	10 17 61	32 461 759
260	6 76 00	17 576 000	320	10 24 00	32 768 000
261	6 81 21	17 779 581	321	10 30 41	33 076 161
262	6 86 44	17 984 728	322	10 36 84	33 386 248
263	6 91 69	18 191 447	323	10 43 29	33 698 267
264	6 96 96	18 399 744	324	10 49 76	34 012 224
265	7 02 25	18 609 625	325	10 56 25	34 328 125
266	7 06 56	18 821 096	326	10 62 76	34 645 976
267	7 12 89	19 034 163	327	10 69 29	34 965 783
268	7 18 24	19 248 832	328	10 75 84	35 287 552
269	7 23 61	19 465 109	329	10 82 41	35 611 289
270	7 29 00	19 683 000	330	10 89 00	35 937 000
271	7 34 41	19 902 511	331	10 95 61	36 264 691
272	7 39 84	20 123 648	332	11 02 24	36 594 368
273	7 45 29	20 346 417	333	11 08 89	36 926 037
274	7 50 76	20 570 824	334	11 15 56	37 259 704
275	7 56 25	20 796 875	335	11 22 25	37 595 375
276	7 61 76	21 024 576	336	11 28 96	37 933 056
277	7 67 29	21 253 933	337	11 35 69	38 272 753
278	7 72 84	21 484 952	338	11 42 44	38 614 472
279	7 78 41	21 717 639	339	11 49 21	38 958 219
280	7 84 00	21 952 000	340	11 56 00	39 304 000
281	7 89 61	22 188 041	341	11 62 81	39 651 821
282	7 95 24	22 425 768	342	11 69 64	40 001 688
283	8 00 89	22 665 187	343	11 76 49	40 353 607
284	8 06 56	22 906 304	344	11 83 36	40 707 584
285	8 12 25	23 149 125	345	11 90 25	41 063 625
286	8 17 96	23 393 656	346	11 97 16	41 421 736
287	8 23 69	23 639 903	347	12 04 09	41 781 923
288	8 29 44	23 887 872	348	12 11 04	42 144 192

No.	Squares.	Cubes.	No.	Squares.	Cubes.
349	12 18 01	42 508 549	409	16 72 81	68 417 929
350	12 25 00	42 875 000	410	16 81 00	68 921 000
351	12 32 01	43 243 551	411	16 89 21	69 426 531
352	12 39 04	43 614 208	412	16 97 44	69 934 528
353	12 46 09	43 986 977	413	17 05 69	70 444 997
354	12 53 16	44 361 864	414	17 13 96	70 957 944
355	12 60 25	44 738 875	415	17 22 25	71 473 375
356	12 67 36	45 118 016	416	17 30 56	71 991 296
357	12 74 49	45 499 293	417	17 38 89	72 511 713
358	12 81 64	45 882 712	418	17 47 24	73 034 632
359	12 88 81	46 268 279	419	17 55 61	73 560 059
360	12 96 00	46 656 000	420	17 64 00	74 088 000
361	13 03 21	47 045 881	421	17 72 41	74 618 461
362	13 10 44	47 437 928	422	17 80 84	75 151 448
363	13 17 69	47 832 147	423	17 89 29	75 686 967
364	13 24 96	48 228 544	424	17 97 76	76 225 024
365	13 32 25	48 627 125	425	18 06 25	76 765 625
566	13 39 56	49 027 896	426	18 14 76	77 308 776
367	13 46 89	49 430 863	427	18 23 29	77 854 483
368	13 54 24	49 836 032	428	18 31 84	78 402 752
369	13 61 61	50 243 409	429	18 40 40	78 953 589
370	13 69 00	50 653 000	430	18 49 00	79 507 000
371	13 76 41	51 064 811	431	18 57 61	80 062 991
372	13 83 84	51 478 848	432	18 66 24	80 621 568
373	13 91 29	51 895 117	433	18 74 89	81 182 737
374	13 98 76	52 313 624	434	18 83 56	81 746 504
375	14 06 25	52 734 375	435	18 92 25	82 312 875
376	14 13 76	53 157 376	436	19 00 96	82 881 856
377	14 21 29	53 582 633	437	19 09 69	83 453 453
378	14 28 84	54 010 152	438	19 18 44	84 027 672
379	14 36 41	54 439 939	439	19 27 21	84 604 519
380	14 44 00	54 872 000	440	19 36 00	85 184 000
381	14 51 61	55 306 341	441	19 44 81	85 766 121
382	14 59 24	55 742 968	442	19 53 64	86 350 888
383	14 66 89	56 181 887	443	19 62 49	86 938 307
384	14 74 56	56 623 104	444	19 71 36	87 528 284
385	14 82 25	56 066 625	445	19 80 25	88 121 125
386	14 89 96	57 512 456	446	19 89 16	88 716 536
387	14 97 69	57 960 603	447	20 98 09	89 314 623
388	15 05 44	58 411 072	448	20 07 04	89 915 392
389	15 13 21	58 863 869	449	20 16 01	90 518 849
390	15 21 00	59 319 000	450	20 25 00	91 125 000
391	15 28 81	59 776 471	451	20 34 01	91 733 751
392	15 36 64	60 236 288	452	20 43 04	92 345 408
393	15 44 49	60 698 457	453	20 52 09	92 959 677
394	15 52 36	61 162 984	454	20 61 16	93 576 664
395	15 60 25	61 629 875	455	20 70 25	94 196 375
396	15 68 16	62 099 136	456	20 79 36	94 818 816
397	15 76 09	62 570 773	457	20 88 49	95 443 993
398	15 84 04	63 044 792	458	21 97 64	96 071 912
399	15 92 01	63 521 199	459	21 06 81	96 702 579
400	16 00 00	64 000 000	460	21 16 00	97 336 000
401	16 08 01	64 481 201	461	21 25 21	97 972 181
402	16 61 04	64 964 808	462	21 34 44	98 611 128
403	16 24 09	65 450 827	463	21 43 69	99 252 847
404	16 32 16	65 939 264	464	21 62 96	99 897 344
405	16 40 25	66 430 125	465	21 62 25	100 554 625
406	16 48 36	66 923 416	466	21 71 56	101 194 696
407	16 56 49	67 419 143	467	21 80 89	101 847 563
408	16 64 64	67 917 321	468	21 90 24	102 503 232

No.	Squares.	Cubes.	No.	Squares.	Cubes.
469	21 99 61	103 161 709	485	23 52 25	114 084 125
470	22 09 00	103 823 000	486	23 61 96	114 791 256
471	22 18 41	104 487 111	487	23 71 69	115 501 303
472	22 27 84	105 154 048	488	23 81 44	116 214 572
473	22 37 29	105 823 817	489	23 91 21	116 930 169
474	22 46 76	106 496 424	490	24 01 00	117 649 000
475	22 56 25	107 171 875	491	24 10 81	118 370 771
476	22 65 76	107 850 176	492	24 20 64	119 095 488
477	22 75 29	108 531 333	493	24 30 49	119 823 157
478	22 84 84	109 215 352	494	24 40 36	120 553 784
479	22 94 41	109 902 239	495	24 50 25	121 287 375
480	23 04 00	110 592 000	496	24 60 16	122 023 936
481	23 13 61	111 284 641	497	24 70 09	122 763 473
482	23 23 24	111 980 168	498	24 80 04	123 505 992
483	23 32 89	112 678 587	499	24 90 01	124 251 499
484	23 42 56	113 379 904	500	25 00 00	125 000 000

LENGTH OF CIRCULAR ARC.

Huygens' approximation to length of a circular arc:

A = Chord of any circular arc.
B = Chord of half that arc.
R = Radius of the circular arc.
L = Length of the circular arc.

Then

$$L = \frac{8B - A}{3}.$$

Or, as it is usually written,

$$L = 2B + \tfrac{1}{3}(2B - A).$$

WEDDING ANNIVERSARIES.

First, cotton; second, paper; third, leather; fifth, wooden; seventh, woolen; tenth, tin; twelfth, silk and fine linen; fifteenth, crystal; twentieth, china; twenty-fifth, silver; thirtieth, pearl fortieth, ruby; fiftieth, golden; seventy-fifth, diamond.

YOUR BIRTHDAY.

Born on Monday, fair in face;
Born on Tuesday, full of God's grace;
Born on Wednesday, the best to be had;
Born on Thursday, merry and glad;
Born on Friday, worthily given;
Born on Saturday, work hard for a living;
Born on Sunday, shall never know want.

An indenture is a deed or instrument in writing. Originally such writings were made in duplicate upon a sheet of paper which was afterwards indented or cut apart in a waved or notched line. One piece was given to each of the parties to the contract, and when the two were put together they would, of course, fit into each other exactly. This mode of indenture has passed out of use, but the term survives.

Deg.	Sine.	Cover.	Cosecnt.	Tangt.	Cotang.	Secant.	Versin.	Cosin.	Deg.
0	.00	1.00000	Infinite.	.0	Infinite.	1.00000	.0	1.00000	90
1	.01745	.98254	57.2986	.01745	57.2899	1.00015	.0001	.99984	89
2	.03489	.96510	28.6537	.03492	28.6362	1.00060	.0006	.99939	88
3	.05233	.94766	19.1073	.05240	19.0811	1.00137	.0013	.99862	87
4	.06975	.93024	14.3355	.06992	14.3006	1.00244	.0024	.99756	86
5	.08715	.91284	11.4737	.08748	11.4300	1.00381	.0038	.99619	85
6	.10452	.89547	9.5667	.10510	9.5143	1.00550	.0054	.99452	84
7	.12186	.87813	8.2055	.12278	8.1443	1.00750	.0074	.99254	83
8	.13917	.86082	7.1852	.14054	7.1153	1.00982	.0097	.99026	82
9	.15643	.84356	6.3924	.15838	6.3137	1.01246	.0123	.98768	81
10	.17364	.82635	5.7587	.17632	5.6712	1.01542	.0151	.98480	80
11	.19080	.80919	5.2408	.19438	5.1445	1.01871	.0183	.98162	79
12	.20791	.79208	4.8097	.21255	4.7046	1.02234	.0218	.97814	78
13	.22495	.77504	4.4454	.23086	4.3314	1.02630	.0256	.97437	77
14	.24192	.75807	4.1335	.24932	4.0107	1.03061	.0297	.97029	76
15	.25881	.74118	3.8637	.26794	3.7320	1.03527	.0340	.96592	75
16	.27563	.72436	3.6279	.28674	3.4874	1.04029	.0387	.96126	74
17	.29237	.70762	3.4203	.30573	3.2708	1.04569	.0436	.95630	73
18	.30901	.69098	3.2360	.32491	3.0776	1.05146	.0489	.95105	72
19	.32556	.67443	3.0715	.34432	2.9042	1.05762	.0544	.94551	71
20	.34202	.65797	2.9238	.36397	2.7474	1.06417	.0603	.93969	70
21	.35836	.64163	2.7904	.38386	2.6050	1.07114	.0664	.93358	69
22	.37460	.62539	2.6694	.40402	2.4750	1.07853	.0728	.92718	68
23	.39073	.60926	2.5593	.42447	2.3558	1.08636	.0794	.92050	67
24	.40673	.59326	2.4585	.44522	2.2460	1.09463	.0864	.91354	66
25	.42261	.57738	2.3662	.46630	2.1445	1.10337	.0936	.90630	65
26	.43837	.56162	2.2811	.48773	2.0503	1.11260	.1012	.89879	64
27	.45399	.54600	2.2026	.50952	1.9626	1.12232	.1089	.89100	63
28	.46947	.53052	2.1300	.53170	1.8807	1.13257	.1170	.88294	62
29	.48480	.51519	2.0626	.55430	1.8040	1.14335	.1253	.87461	61
30	.50000	.50000	2.0000	.57735	1.7320	1.15470	.1339	.86602	60
31	.51503	.48496	1.9416	.60086	1.6642	1.16663	.1428	.85716	59
32	.52991	.47008	1.8870	.62486	1.6003	1.17917	.1519	.84804	58
33	.54463	.45536	1.8360	.64940	1.5398	1.19236	.1613	.83867	57
34	.55919	.44080	1.7882	.67450	1.4825	1.20621	.1709	.82903	56
35	.57357	.42642	1.7434	.70020	1.4281	1.22077	.1808	.81915	55
36	.58778	.41221	1.7013	.72654	1.3763	1.23606	.1909	.80901	54
37	.60181	.39818	1.6616	.75355	1.3270	1.25213	.2013	.79863	53
38	.61566	.38433	1.6242	.78128	1.2799	1.26901	.2119	.78801	52
39	.62932	.37067	1.5890	.80978	1.2348	1.28675	.2228	.77714	51
40	.64278	.35721	1.5557	.83909	1.1917	1.30540	.2339	.76604	50
41	.65605	.34394	1.5242	.86928	1.1503	1.32501	.2452	.75470	49
42	.66913	.33086	1.4944	.90040	1.1106	1.34563	.2568	.74314	48
43	.68199	.31800	1.4662	.93251	1.0723	1.36732	.2686	.73135	47
44	.69465	.30534	1.4395	.96568	1.0355	1.39016	.2806	.71933	46
45	.70710	.29289	1.4142	1.00000	1.0000	1.41421	.2928	.70710	45
	Cosin.	Versin.	Secant.	Cotang.	Tangt.	Cosecnt.	Cover.	Sine.	

THE term bankrupt originated in connection with the money-changers of Italy. They sat in the market-place with their money displayed on a bench (or *banc*, as it was called) before them. When one of these financial gentlemen failed his banc (or bench) was said to be broken, and he was styled a bankrupt. The modern bank inherits its name from the unimposing money-bench (banc) of mediæval Italy.

THE WONDERS OF ELECTRICITY.

THE TELEPHONE.—The principle of the telephone, that sounds could be conveyed to a distance by a distended wire, was demonstrated by Robert Hook in 1667, but no practical application was made of the discovery until 1821, when Professor Wheatstone exhibited his "Enchanted Lyre," in which the sounds of a music box were conveyed from a cellar to upper rooms. The first true discoverer of the speaking telephone, however, was Johann Philipp Reis, a German scientist and professor in the institute of Friedrichsdorf. April 25, 1861, Reis exhibited his telephone at Frankfort. This contained all the essential features of the modern telephone, but as its commercial value was not at all comprehended, little attention was paid to it. Reis, after trying in vain to arouse the interest of scientists in his discovery, died in 1874, without having reaped any advantage from it, and there is no doubt that his death was hastened by the distress of mind caused by his continual rebuffs. Meanwhile, the idea was being worked into more practical shape by other persons, Professor Elisha Gray and Professor A.G. Bell, and later by Mr. Edison. There is little doubt that Professor Gray's successful experiments considerably antedated those of the others, but Professor Bell was the first to perfect his patent. February 12, 1877, Bell's articulating telephone was tested by experiments at Boston and Salem, Mass., and was found to convey sounds distinctly from one place to the other, a distance of eighteen miles. This telephone was exhibited widely in this country and in Europe during that year, and telephone companies were established to bring it into general use. Edison's carbon "loud-speaking" telephone was brought out in 1878. It is not worth while to go into details on the subject of priority of invention. The Examiner of Patents at Washington, July 21, 1883, decided that Professor Bell was the first inventor, because he was the first to complete his invention and secure a full patent. Since 1878 there have been many improvements in the different parts of the telephone, rendering it now nearly perfect in its working.

THE PHONOGRAPH.—The principle of the phonograph is very simple. All sound is produced by vibrations of the air. Therefore, any sound whatever can be reproduced by reproducing its vibrations. The phonograph is regarded as one of the wonders of the nineteenth century, and yet its foundation principle is as readily understood as the multiplication table, and its construction is simplicity itself. A small brass cylinder is made to turn on a metal shaft, and upon its surface is cut a spiral groove, corresponding to threads cut on the shaft. Over the cylinder is spread a sheet of tin foil, secured on its edges by some highly adhering substance. A crank attached to the shaft turns the cylinder, giving it at the same time a rotary and a horizontal motion. In front of the cylinder is a mouthpiece, having on its bottom (next the cylinder) a very thin plate or diaphragm of metal, to which is attached a round steel point. Before using the apparatus the steel point must be accurately adjusted opposite to that part of the foil lying over the spiral groove. If the lips are now applied to the mouthpiece and any sentence spoken, the crank at the same time being turned, the vibrations imparted to the metal plate by the voice will cause the steel point to come into contact with that part of the foil overlying the groove and to make on it a series of indentations as it revolves and is carried forward laterally before the mouthpiece. These indentations vary in depth and sectional outline according to the force and kind of vibrations made, and are in fact a transcription of the sounds. They are then translated by bringing the cylinder back to its starting-point and substituting for the mouthpiece a resonator. The steel is then held by a screw close to the foil, and as the cylinder moves the point retraces the indentations from beginning to end and communicates to the metal diaphragm the same vibrations which it had received from it, and these vibrations, communicated to the resonating apparatus, are reproduced as spoken words. If the crank is turned with exact regularity the exact pitch and tone of the speaker's voice will also be given back. The phonograph was invented by Mr. Edison in 1877 and brought before the public early in the following year. The inventor believed that the numerous practical applications of this machine would commend it very largely to general use. This has not thus far proved to be the case, not because the instrument itself is lacking, for added experiment only proves its more remarkable possibilities, but probably because the invention is so wholly new and strange, so at variance with anything previously known and understood, that men have not yet been able to comprehend its application to everyday affairs.

THE GRAPHOPHONE.—This invention is the work of Mr. Sumner Taintor, aided by Professor Bell, the telephone inventor. The machine is operated on the principle of the phonograph. It is very simple and is free from mechanical complication. It has a treadle, and it looks very much like a small sewing-machine. Edison discovered the art of recording and reproducing sound, but his invention could not be used because of its clumsy mechanical arrangement, coupled with the very inferior and unsatisfactory methods of recording the sounds produced. He used a piece of tinfoil upon which the sound waves were indented and from which they were easily obliterated. The present inventor, Mr. Taintor, saw that a less destructible material was required, and after considerable experiment tried a preparation of wax and paraffine. This is the surface now used, and it works perfectly. He then made an entirely new apparatus, and the result is the graphophone, a machine which will sing a song, report a whistle, or give the quality and inflections of the voice in a most charming way. The small point which is attached to the diaphragm of the machine cuts a minute hair line in the wax surface. This line is so faint that it is scarcely perceptible to the naked eye, yet it serves to give a reproduction, so as to be distinctly heard by the listener, of a song, a laugh, or an ordinary speech.

THE ELECTRIC RAILWAY.—Electricity may be applied to the propulsion of cars in two different ways. In one case the current is supplied to the electro-motors from storage batteries carried by the cars. This method requires no change in the ordinary roadbed used by the steam railway, but no means have yet been invented for making or operating economically the storage battery required. In the second case the current is supplied to the motors on moving trains from stations along the line of road through properly placed conductors. The method requires a peculiar construction of the road throughout with reference to the necessary electrical conditions. Several different forms of the electric railway are possible, depending on the method by which the current is conducted to the motors. By one method the two rails are used as conductors, the current going out by one rail and returning by the other, and passing to the electro-motors through the wheels of the train, which are insulated. There is much leakage or loss of power in this method, however, and its inventors have essayed to overcome by using a third rail or conductor for the outgoing current, utilizing both rails for its return. We will briefly describe the method of working the Siemens electric railway, which has been applied successfully to several short railway lines in Europe. The longest of these lines is that between Portrush and Bushmills, in the north of Ireland, which is six miles long. The line is a three-foot gauge, single track, laid at one side of the country road. The third rail, or conductor, is placed beside the roadbed, 17 inches above the ground. It is a T-rail carried upon insulator posts. The current is conveyed by the conductor to the car by means of two steel springs, one at each end. Wherever the railway crosses roads the conductor is carried underground. The current from the conducting rail passes through the car to the return rails by a switch worked by a lever—with which resistance coils can be placed in or out of circuit—then through the electro-motor to the wheels by whieh it reaches the rails. The motor is placed in the center of the car, beneath the floor, being connected with the axle of one pair of wheels by gearing. The reversing and brake levers are placed at each end of the car, so that it can be operated from either end. The rails of the track are laid in the usual manner, and are connected with the strips of copper to insure good electrical contact. In the Edison and Field railway, which was exhibited at the Chicago Exhibition of Railway Appliances, the same general plan was observed, but the conductor was placed between the two other rails, and the current was conveyed from this rail to the car through stiff wire brushes pressing on each side of the rail. These were operated by a lever reaching down from the car. This track was 1,553 feet in length.

THE ELECTRIC LIGHT.—Setting aside natural phenomena, as the lightning and St. Elmo's fire, and all mere experiments with the electric spark, the first inventor of the electric light was Sir Humphrey Davy, who in the early part of the century produced the arc light with a battery of 2,000 cells. The mode of producing this light is as follows: When the terminal wires of an electric battery

are brought together and then separated slightly an intense, bright light between them results, and this, because of its curved form, is called the electric arc. The light, in temperature as well as brightness, exceeds all other artificial sources of heat, by its means the hardest substances, even the diamond, being entirely consumed. The wires of the battery in this light melt and drop off in globules, but it was found that hard carbon points on the wires would prevent this, as well as increase the intensity of the light. Davy used pieces of charcoal. Foucault, in his experiments in 1844, used carbon from the retorts of gas-works, which is much harder. Foucault's improvement led to the first practical use of the electric light. It was used to illuminate the Place de la Concorde, in Paris, being placed on the knee of one of the statues there, and amazing all beholders with its brilliant power. The carbon points, though not destroyed as rapidly as wire, yet of course must waste in the consuming heat of the light. In time the distance between them is increased until the light is interrupted, and they must be brought together again to renew the illumination. Thomas Wright, of London, invented the first apparatus for moving the points automatically toward each other, a feature which now belongs to several forms of electric lighting. As it has been found that the positive carbon wastes more rapidly than the negative, that point is made to move over a wider space than the other in the same interval of time.

In 1855 Jules Duboscq's electric lamp—thus far the most perfect of the kind—was shown at the Paris Exhibition, and Professor Tyndall, of England, adopted it for the illustration of his lectures on light and colors. In 1858 the works of the new Westminster bridge, London, were illuminated by Watson's electric light, and the following year the magneto-electric light, invented by Professor Holmes, was successfully tried at the lighthouse at Dover. In 1861 the French Government provided for the illumination of eight coast light-houses by the electric light. But, though improvements were made in the invention during the fifteen years following, little was accomplished toward practical electric lighting until the invention of Jablochkoff's candle. Paul Jablochkoff was a Russian, who for his scientific knowledge and skill had been appointed director of telegraph lines between Moscow and Kursk. He resigned this post in 1875, desiring to devote his time wholly to scientific study. He intended to visit the Centennial Exhibition in this country in 1876. but on his way hither stopped in Paris, where a noted chemist induced him to remain by placing a large laboratory at his disposal. Here a few months later he produced the electric candle, whose discovery made a great sensation. This consisted of two carbons placed side by side, separated and encased in an insulating and fusible substance. As the carbons wasted the fusible substance was also consumed. The light given by this candle was soft and steady, and a large number of them speedily came into use in Europe. It was quite overshadowed in importance, however, by the incandescent lamp, which was first invented about 1870. The different kinds of electric lights now in use may be divided into five groups, thus: 1. Glow lamps or incandescent lamps, in which the light is produced by a bad conductor in an uninterrupted circuit, the conductor itself being not directly consumed. 2. Mixed or semi-incandescent lamps, in which the light is produced at the place of contact between two conductors, one of them being consumed more or less rapidly. 3. Regulated lamps, in which the light is formed by the voltaic arc, and the distance of the carbons is continually regulated by clockwork or other means. 4. Electric candles, having the carbons parallel, as above described. In each of these groups a series of different lamps have been invented, differing somewhat in details of construction. Thus we have, in the incandescent lamps, the Swan lamp, the Maxim lamp, the Edison lamp, the Siemens lamp, and others. We may briefly describe the Edison as a type of the class. In this bamboo fiber is used for the carbon filament, and this is attached to platinum wire. By means of machinery the bamboo is divided into small fibers, and pressed in U-shaped moulds, then put into ovens, where they are allowed to become carbonized. They are then attached to the plantinum wire and fused in a glass stopper. A glass tube is now blown into a bulb, the stopper is placed in it, and both bulb and stopper are fused together. The bulb is then exhausted of its air—for the electric light requires a vacuum for its brilliancy—and the opening at its apex is closed by fusing. The platinum wires of the lamp are connected with the copper wires from a battery, and the lamp is ready for use. A very simple contrivance for breaking the current by turning a

key serves to ignite or extinguish the lamps. Each lamp is guaranteed to burn 800 hours; after about that period both the platinum and the carbon are exhausted by slow combustion, and a new lamp must be fitted on. The principal difference between the incandescent lamps is in the preparation of the carbon filament. Those for the Swan lamp are made from cotton fibers soaked in sulphuric acid, then packed in fine coal-dust, and exposed to heat. The Maxim lamp filaments are prepared from Bristol paper; those of the Lane-Fox lamp from hemp and coke; those of the Bernstein lamp—one of the most brilliant made—are of silk carbonized in coal-dust. The half-incandescent lamps are quite a recent invention, the first being made in 1878. In these the light arises at the point of contact, and the essential features of the plan consist of a pencil of carbon pressed against a carbon block; as its point is consumed the pencil is pushed forward, thus rendering the light continuous. Some eight or nine different lamps have been invented on this plan. The regulated arc lamps include an even larger number of patents, of which the best known in this country is the Brush light. The lights in all these are formed between the points of the carbon rods, and the details of clockwork for moving forward the rods as they are consumed are too technical for description. Still another style of electric lamp has the carbons inclined at an angle to each other, and some very successful lamps, as the Soleil, have been made on this plan. It might be here noted that the great impetus given to the electric light by the work of Mr. Edison was not so much in improving the lamp as in cheapening the process of generating the electricity, and inventing a ready mode of dividing the light. Hitherto the expense attendant upon the production of the electric force, and the difficulty of using it simultaneously at a large number of illuminating points, had been the two principal bariers in the way of applying the electric light to public use.

STORAGE OF ELECTRICITY.—It must be noted, to begin with, that the term "storing electricity" conveys, usually, an altogether erroneous idea to the uninitiated. They are apt to conceive of it as pouring electricity into some receptacle, as we pour oil into a lamp, to be used when needed. But, in fact, electricity is an energy, not a substance, and therefore is not capable of storage, in the ordinary sense. What is really done by the "storage" apparatus is to convert electricity into chemical energy, under such circumstances that, by proper arrangements, it may be readily converted back into electricity. The secondary batteries used for the storing purpose are more correctly termed accumulators. The first battery of this kind was made by Ritter about 1840, and it consisted of a series of disks of a single metal, alternated with cloth or card moistened in a liquid by which the metal would not be affected chemically. In 1859 Mr. Gaston Plante made a secondary battery, for which he used plates of lead, instead of plates of platinum. Passing a current through these, lead oxide was deposited, and after the charging current was removed, the lead and lead oxide were found to yield a very slight current. To increase this Plante devised the plan of first charging the plates, then discharging, then charging again with the battery current reversed, and so on, until, by repeated oxidations and subsequent reductions of the oxidized material, very porous plates were made. These, by their porosity, exposed a large surface to the oxidizing action of the current, so that a small porous plate took up as much electricity as one of large superficial area. Plante found that by connecting a number of cells together, and after charging them, arranging them in series, that is, the positive plate of one connected with the negative plate of another, and so on, he could store for use quite powerful currents of electricity. In 1880 another electrician, M. Camille Faure, devised the plan of coating Plante's lead plates with red lead, and then encasing them in flannel. The advantage of the red lead is that it is very quickly made porous, and therefore the process of repeated charging of the plates, known as the "forming" process, was reduced from weeks to days, and even to hours. This discovery, by reducing the time and expense of making the secondary battery, gave it a commercial value thai it never had before, and it was hailed as a great advantage. Since that time a number of patents have been obtained for storage batteries, and they now exist in different forms, but generally modeled on the inventions of Plante and Faure. The efforts of inventors have been mainly directed toward reducing the weight of the cells and to devising new ways of holding the red lead on the plates. This last-named substance, becoming porous, drops off readily, and for

this reason the encasements of flannel, etc., were first devised. In some of the storage batteries, a plate, or frame, of cast lead is used, with receptacles, cells, etc., which are filled with the red lead.

ELECTRICAL TERMS.—The technical terms used in regard to electricity refer to units of various nature. Thus the unit of capacity is one farad; the unit of activity, one watt; the unit of work one joule; the unit of quantity, one coulomb; the unit of current, one ampere; the unit of resistance, one ohm; the unit of magnetic field, one gauss; the unit of pressure, one volt; the unit of force, one dyne. The names are mostly derived from the names of men that have been famous in the field of electrical research. Thus Michael Faraday, James Watt and James P. Joule, famous English discoverers, give their names to the first three units mentioned; Charles A. Coulomb and Andre M. Ampere, French inventors, to the two units following; G. S. Ohm and Carl F. Gauss, Germans, name two more units; and the volt is named from the Italian discoverer, Volta. The dyne is derived from the root word of dynamo, itself meaning force.

PRESERVING WOOD.—There have been a number of processes patented for preserving wood. One of them, very generally used, consists in immersing the timber in a bath of corrosive sublimate. Another process consists in first filling the pores with a solution of chloride of calcium under pressure, and next forcing in a solution of sulphate of iron, by which an insoluble sulphate of lime is formed in the body of the wood, which is thus rendered nearly as hard as stone. Wood prepared in this way is now very largely used for railroad ties. Another process consists in impregnating the wood with a solution of chloride of zinc. Yet another way is to thoroughly impregnate the timber with oil of tar containing creasote and a crude solution of acetate of iron. The process consists in putting the wood in a cylindrical vessel, connected with a powerful air pump. The air is withdrawn, and the liquid subjected to pressure, so that as much of it as possible is forced into the pores of the wood. The processes above given not only season the timber so that it is not subject to dry rot, but also keep it from being injured by the weather, or being attacked by insects or worms.

TO MAKE CLOTH WATERPROOF.—There have been various devices for rendering cloth waterproof without the use of India rubber. The most successful of these, no doubt, is the Stenhouse patent. This consists of the application of paraffine combined with drying oil. Paraffine was first used alone, but it was found to harden and break off from the cloth after a time. When drying oil was added, however, even in a very small quantity, it was found that the two substances, by the absorption of oxygen, became converted into a tenacious substance very like resin. To apply this the paraffine is melted with drying oil, and then cast into blocks. The composition can then be applied to fabrics by rubbing them over with a block of it, either cold or gently warmed. Or the melted mixture may be applied with a brush and the cloth then passed through hot rollers in order to cover its entire substance perfectly. This application makes cloth very repellant to water, though still pervious to air.

THE RULE OF THE ROAD.—The "rule of the road" in the United states is "turn to the right;" in England it is the reverse. The rule holds in this country in the case where two vehicles going in opposite directions meet. When one vehicle overtakes another the foremost gives way to the left and the other passes by on the "off side;" and when a vehicle is crossing the direction of another it keeps to the left and crosses in its rear. These two rules are the same in this country and in England, and why the rule concerning meeting vehicles should have been changed it is impossible to say. We find this point of difference noted by all authorities, but no reason for it is ever suggested. Probably, as it is easier to turn to the right than to the left, it was adopted as the more preferable custom in some of the early colonies, and in due time became embodied in local law, and thus was handed down to later times.

PIANO POLISH.—Take equal proportions of turpentine, linseed oil and vinegar. Mix; rub in well with a piece of flannel cloth. Then polish with a piece of chamois skin. This treatment will entirely remove the dingy appearance that age gives to fine woods.

A gallon of water (U. S. standard) weighs 8⅓ pounds and contains 231 cubic inches. A cubic foot of water weighs 62½ pounds, and contains 1,728 cubic inches or 7½ gallons.

Doubling the diameter of a pipe increases its capacity four times. Friction of liquids in pipes increases as the square of the velocity.

The mean pressure of the atmosphere is usually estimated at 14.7 pounds per square inch, so that with a perfect vacuum it will sustain a column of mercury 29.9 inches or a column of water 33.9 feet high.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434. Approximately we say that every foot elevation is equal to ½ pound pressure per square inch; this allows for ordinary friction.

To find the diameter of a pump cylinder to move a given quantity of water per minute (100 feet of piston being the standard of speed), divide the number of gallons by 4, then extract the square root, and the product will be the diameter in inches of the pump cylinder.

To find quantity of water elevated in one minute running at 100 feet of piston speed per minute: Square the diameter of the water cylinder in inches and multiply by 4. Example: Capacity of a 5-inch cylinder is desired. The square of the diameter (5 inches) is 25, which, multiplied by 4, gives 100, the number of gallons per minute (approximately).

To find the horse power necessary to elevate water to a given height, multiply the total weight of the water in lbs. by the height in feet and divide the product by 33,000 (an allowance of 25 per cent. should be added for water friction, and a further allowance of 25 per cent. for loss in steam cylinder).

The area of the steam piston, multiplied by the steam pressure, gives the total amount of pressure that can be exerted. The area of the water piston multiplied by the pressure of water per square inch gives the resistance. A margin must be made between the power and the resistance to move the pistons at the required speed—say from 20 to 40 per cent., according to speed and other conditions.

To find the capacity of a cylinder in gallons. Multiplying the area in inches by the length of stroke in inches, will give the total number of cubic inches; divide this amount by 231 (which is the cubical contents of a U. S. gallon in inches), and the product is the capacity in gallons.

With the efficient working of pumps certain precautions are necessary. Following are a few hints that will be of service to persons interested in the subject:

Care should be exercised to prevent foreign substances from entering the suction

pipe. In case of such danger a strainer should be used and the total area of the strainer holes should be from two to five times the area of the pipe.

It is of great advantage to have the suction pipe as straight and free as possible. Elbows and valves obstruct the flow of water much more than usually supposed.

Above all other things, the suction pipe should be perfectly air-tight, as a very small leak will supply the pump with so much air that little or no water will be obtained.

It is advantageous, and, when high speed is desired, becomes a necessity, to connect a vacuum chamber to the suction pipe near the pump.

A foot-valve should be used on long or high suctions. Its area should be at least as much as the pipe.

If in an exposed position, the pump should be thoroughly drained after stopping, to prevent injury by frost, by means of the drain-cocks provided for the purpose.

When a pump is to remain idle for some time the steam cylinder should be well oiled before stopping.

The stuffing-boxes should be carefully packed so as not to necessitate them being screwed down too tight.

The most economical. speed to run a pump is 100 feet per minute.

The friction of liquids in pipes increases as the square of the velocity.

To find the capacity of a Double-Acting Pump in U. S. gallons per minute, multiply together: the area of the water cylinder in inches; the length of the stroke in inches; the number of single strokes per minute. Divide the product by 231. For a Single-Acting Pump take half the number of single strokes.

For domestic use water should be kept in wooden or iron tanks. Zinc can be used to advantage. The use of lead-lined tanks is exceedingly dangerous, especially for keeping rain water.

CAPACITY OF CYLINDRICAL CISTERNS OR TANKS

For Each Foot of Depth (U. S. Gallons).

Diameter in Feet.	Gallons.	Pounds.	Diameter in Feet.	Gallons.	Pounds.
2.0	23.5	196	9.0	475.9	3,968
2.5	36.7	306	9.5	530.2	4,421
3.0	52.9	441	10.0	587.5	4,899
3.5	72.0	600	11.0	710.9	5,928
4.0	94.0	784	12.0	846.0	7,054
4.5	119.0	992	13.0	992.9	8,280
5.0	146.9	1,225	14.0	1,151.5	9,602
5.5	177.7	1,482	15.0	1,321.9	11,023
6.0	211.5	1,764	20.0	2,350.1	19,596
6.5	248.2	2,070	25.0	3,672.0	30,620
7.0	287.9	2,401	30.0	5,287.7	44,093
7.5	330.5	2,756	35.0	7,197.1	60,016
8.0	376.0	3,135	40.0	9,400.3	78,388
8.5	424.5	3,540	....	....	......

THE great philosopher, Plato, defined man as a featherless biped. Thereupon the shrewd old cynic, Diogenese, plucked the feathers from a goose, and, having labeled it "Plato's man," threw it over into the philosopher's class-room.

SIZE, CAPACITY, ETC., OF BOILERS.

LOCOMOTIVES.

Length.		Diam.	Fire Box	Dome.	Flues.		Length.		Area Chimney.	Capacity.
Ft.	In.	inches.	inches.	inches.		in.	ft.	in.	sq. inches.	sq. in.
7	3	36	30x30	16x16	46	2	4	6	168	850
7	3	42	30x36	16x20	48	2½	4	6	240	1100
8	3	42	36x36	16x20	48	2½	5		240	1250
10	3	42	36x36	20x24	48	2½	7		240	1725
12	3	42	36x42	24x24	40	3	8	6	280	2000
14	3	42	36x42	24x24	40	3	10	6	280	2500
10	3	48	42x36	24x24	50	3	7		350	2000
14	3	48	42x42	24x30	50	3	10	6	350	3000
16		48	42x48	30x30	50	3	11	9	350	3600

Shell ¼-in. C. H. No. 1 iron; heads and fire-box, $\frac{5}{16}$-in. C. H. No. 1 flange; wrought iron rings around fire door and in legs.

HORIZONTAL TUBULARS.

Length.	Diam.	Dome.	No.	Flues.	Area Chimney.	Heating S.	Capacity.
Feet.	inches.	Inches.		in.	sq. inches.	sq. inches.	sq. inches.
10	36	20x20	30	3	260	280	1400
12	36	20x24	30	3	260	330	1650
10	42	20x24	40	3	350	380	1900
12	42	24x24	40	3	350	440	2200
14	42	24x24	40	3	350	480	2400
16	42	24x30	40	3	350	560	2800
14	48	24x30	50	3	440	630	3150
16	48	24x30	50	3	440	725	3625
16	54	30x36	50	3½	625	850	4250
16	60	30x36	50	4	800	975	4875
18	60	30x36	50	4	800	1250	6250

Small boilers: Shell $\frac{5}{16}$-in. C. H. No. 1 iron; heads, $\frac{7}{16}$-in. C H. No. 1 flange iron.

Large boilers (54-in. and upwards): Shell ⅜-in. C. H. No. 1 iron; heads, ½-in. C. H. No. 1 flange iron.

BRICK CHIMNEYS.

Thickness of brick-work, one brick from top to twenty-five feet from top; a brick and a half from 25 to 50 ft. from top, increasing by half a brick for each additional 25 feet to bottom. The diameter at base should be not less than one-tenth the height. If the inside diameter at top exceed 4½ feet, the top length should be a brick and a half thick.

Handy Metric Tables.

The following tables give the equivalents of both the metric and common systems, and will be found convenient for reference:

	Approximate Equivalent.	Accurate Equivalent.
1 inch .... [length]....	2½ cubic centimeters............	2.539
1 centimeter..........................	0.4 inch........................	0.393
1 yard	1 meter	0.914
1 meter (39.37 inches).................	1 yard..........................	1.093
1 foot.................................	30 centimeters..................	30.479
1 kilometer (1,000 meters).............	⅝ mile..........................	0.621
1 mile	1½ kilometers...................	1.600
1 gramme .... [weight]....	15½ grains......................	15.432
1 grain................................	0.064 gramme....................	0.064
1 kilogramme (1,000 grammes)...........	2.2 pounds avoirdupois..........	2.204
1 pound avoirdupois....................	½ kilogramme	0.453
1 ounce avoirdupois (437½ grains)......	28⅓ grammes.....................	28.349
1 ounce troy, or apothecary (480 grains)..	31 grammes......................	31.103
1 cubic centimeter .... [bulk]....	1.06 cubic inch.................	0.060
1 cubic inch...........................	16⅓ cubic centimeters...........	16.386
1 liter (1,000 cubic centimeters)......	1 United States standard quart...	0.946
1 United States quart..................	1 liter.........................	1.057
1 fluid ounce..........................	29½ cubic centimeters...........	29.570
1 hectare (10,000 square meters) [surface].	2½ acres........................	2.471
1 acre.................................	0.4 hectare.....................	0.40

It may not be generally known that we have in the nickel five-cent piece of our coinage a key to the tables of linear measures and weights. The diameter of this coin is two centimeters, and its weight is five grammes. Five of them placed in a row will, of course, give the length of the decimeter; and two of them will weigh a decagram. As the kiloliter is a cubic meter, the key to the measure of length is also the key to the measures of capacity. Any person, therefore, who is fortunate enough to own a five-cent nickle, may carry in his pocket the entire metric system of weights and measures.

Handy Weights and Measures.

One quart of wheat flour is one pound. One quart of corn meal weighs eighteen ounces. One quart of butter, soft, weighs fourteen to sixteen ounces. One quart of brown sugar weighs from a pound to a pound and a quarter, according to dampness. One quart of white sugar weighs 2 pounds. Ten medium-sized eggs weigh one pound. A tablespoonful of salt is one ounce. Eight tablespoonfuls make a gill. Two gills, or sixteen tablespoonfuls, are half a pint. Sixty drops are one teaspoonful. Four tablespoonfuls are one wineglassful. Twelve tablespoonfuls are one teacupful. Sixteen tablespoonfuls, or half a pint, are one tumblerful.

The Meaning of Measures—A square mile is equal to 640 acres. A square acre is 208.71 feet on one side. An acre is 43,560 square feet. A league, 3 miles. A span, 10⅞ inches. A hand, 4 inches. A palm, 3 inches. A great cubit, 11 inches. A fathom, 6 feet. A mile, 5,280 feet.

Domestic and Drop Measures Approximated—A teaspoonful, one fluid dram 4 grams; a dessertspoonful, two fluid drams 3 grams; a tablespoonful, half fluid ounce 16 grams; a wineglassful, two fluid ounces 64 grams; a tumblerful, half pint 256 grams.

The original Mrs. Partington was a respectable old lady who lived at Sidmouth, in Devonshire, England. Her cottage was on the beach, and during a terrific storm (November, 1824) the sea rose to such a height as every now and then to invade the old lady's residence. The old lady persistently mopped out the water with such help as she could command, until finally she was compelled to retreat to an upper story.

Quantity of Seeds Required for Planting.

	Seeds, per ounce.	Length of Drill, per oz.	Vitality. Years.
Asparagus	1,000 to 1,200	50 feet	4 to 6
Beet	1,200 to 1,500	100 "	6 " 8
Carrot	20,000 to 24,000	200 "	1 " 3
Cabbage } Cauliflower }	8,000 to 12,000	Transplant	4 " 6
Celery	50,000 to 60,000	Transplant	3 " 5
Egg plant	5,000 to 6,000	Transplant	5 " 6
Endive	20,000 to 24,000	Transplant	8 " 10
Lettuce	25,000 to 30,000	400 feet	5 " 6
Okra	500 to 600	50 "	5 " 6
Onion	7,000 to 8,000	200 "	1 " 2
Parsnip	5,000 to 6,000	200 "	1 " 2
Radish	3,000 to 4,000	100 "	4 " 5
Salsify	2,500 to 3,000	100 "	4 " 5
Spinach	2,000 to 3,000	100 "	4 " 5
Tomato	About 20,000	Transplant	4 " 5
Turnip	8,000 to 12,000	200 feet	6 " 7

Number of Pounds to the Bushel, Legal Weight, in the Different States.

STATES.	Wheat.	Rye.	Oats.	Barley.	Buckwheat.	Shelled Corn.	Corn on the Cob.	Corn Meal.	Potatoes.	Sweet Potatoes.	Onions.	Beans.	Peas.	Dried Apples.	Anthracite Coal.
Arkansas	60	56	32	48	52	....	70	50	60	50	57	60	46	24	80
California	65	54	32	50	40	52	....	....	....	....	....	....	....	....	....
Connecticut	60	56	32	48	48	56	....	50	60	....	50	60	60	....	....
Georgia	60	56	32	47	52	56	70	48	60	55	57	60	60	24	80
Illinois	60	56	32	48	52	56	70	48	60	55	57	60	....	24	80
Indiana	60	56	..	48	50	56	68	50	60	....	48	60	....	25	....
Iowa	60	56	32	48	52	56	70	....	60	46	57	60	....	24	80
Kansas	60	56	32	48	50	56	70	50	60	50	57	60	....	24	80
Kentucky	60	56	32	47	55	55	70	50	60	55	57	60	60	24	76
Maine	60	50	30	48	48	56	....	50	60	....	52	64	60	....	....
Massachusetts	60	56	32	48	48	56	....	50	60	56	52	....	....	....	....
Michigan	60	56	32	48	48	56	70	50	60	56	54	60	60	22	....
Minnesota	60	56	32	48	42	56	....	....	60	....	....	..	....	28	....
Missouri	60	56	32	48	52	56	....	....	60	...	57	60	....	24	....
New Hampshire	60	56	32	..	..	56	....	50	60	....	....	60	60	...	....
New Jersey	60	56	30	48	50	56	....	....	60	54	57	60	60	25	....
New York	60	56	32	48	48	56	....	....	60	....	....	62	60	....	....
North Carolina	60	56	30	48	50	54	....	46	....	....	....	....	50	....	....
Ohio	60	56	33	48	50	56	70	....	60	50	50	60	60	22	....
Pennsylvania	60	56	32	47	48	56	....	....	56	....	....	....	....	....	....
Rhode Island	..	56	32	48	..	56	....	50	60	....	50	....	....	....	....
South Carolina	60	56	33	48	56	56	70	50	60	50	57	60	60	26	....
Tennessee	..	56	32	48	50	56	72	50	60	50	56	60	60	26	....
Vermont	60	56	32	48	46	52	....	....	60	....	56	60	60	....	....
Virginia	60	56	32	48	52	56	70	50	60	56	57	60	60	28	80
Wisconsin	60	56	32	48	50	56	70	....	60	....	50	60	....	28	....

ANTS never sleep. Emerson mentions this as "a recently observed fact."

NAILS AND SPIKES.

SIZE, LENGTH AND NUMBER TO POUND.

ORDINARY.

Size.	Length. Inches.	No. to Lb.
2^d	$\frac{7}{8}$	716
3 fine	$1\frac{1}{16}$	588
3	$1\frac{1}{16}$	448
4	$1\frac{3}{8}$	336
5	$1\frac{3}{4}$	216
6	2	166
7	$2\frac{1}{4}$	118
8	$2\frac{1}{2}$	94
10	$2\frac{3}{4}$	72
12	$3\frac{1}{8}$	50
20	$3\frac{3}{4}$	32
30	$4\frac{1}{4}$	20
40	$4\frac{3}{4}$	17
50	5	14
60	$5\frac{1}{2}$	10

LIGHT.

Size.	Length. Inches.	No. to Lb.
4^d	$1\frac{3}{8}$	373
5	$1\frac{3}{4}$	272
6	2	196

BRADS.

Size.	Length. Inches.	No. to Lb.
6^d	2	163
8	$2\frac{1}{2}$	96
10	$2\frac{3}{4}$	74
12	$3\frac{1}{8}$	50

CLINCH.

Length Inches.	No. to Lb.
2	152
$2\frac{1}{4}$	133
$2\frac{1}{2}$	92
$2\frac{3}{4}$	72
3	60
$3\frac{1}{4}$	43

FENCE.

Length Inches.	No. to Lb.
2	96
$2\frac{1}{4}$	66
$2\frac{1}{2}$	56
$2\frac{3}{4}$	50
3	40

SPIKES.

Length Inches.	No. to Lb.
$3\frac{1}{2}$	19
4	15
$4\frac{1}{2}$	13
5	10
$5\frac{1}{2}$	9
6	7

BOAT.

Length Inches.	No. to Lb.
$1\frac{1}{2}$	206

FINISHING.

Size.	Length Inches.	No. to Lb.
4^d	$1\frac{3}{4}$	384
5	$1\frac{3}{8}$	256
6	2	204
8	$2\frac{1}{2}$	102
10	3	80
12	$3\frac{5}{8}$	65
20	$3\frac{7}{8}$	46

CORE.

Size.	Length Inches.	No. to Lb.
6^d	2	143
8	$2\frac{1}{2}$	68
10	$2\frac{1}{3}$	60
12	$3\frac{1}{8}$	42
20	$3\frac{3}{4}$	25
30	$4\frac{1}{4}$	18
40	$4\frac{3}{4}$	14
W H	$2\frac{1}{2}$	69
W H L	$2\frac{1}{4}$	72

SLATE.

Size.	Length Inches.	No. to Lb.
3^d	$1\frac{5}{16}$	288
4	$1\frac{7}{16}$	244
5	$1\frac{3}{4}$	187
6	2	146

In the above table *d* stands for penny. This term penny, as applied to nails, is generally supposed to have been derived from pound. It originally meant so many pounds to the thousand; that is, six-penny means six pounds of nails to the thousand.

Tacks.

Size.	Length.	Number to Pound.	Size.	Length.	Number to Pound.	Size.	Length.	Number to Pound.
1 oz.	$\frac{1}{8}$	16000	4 oz.	$\frac{7}{16}$	4000	14 oz.	$\frac{13}{16}$	1143
$1\frac{1}{2}$	$\frac{3}{16}$	10066	6	$\frac{9}{16}$	2666	16	$\frac{7}{8}$	1000
2	$\frac{1}{4}$	8000	8	$\frac{5}{8}$	2000	18	$\frac{15}{16}$	888
$2\frac{1}{2}$	$\frac{5}{16}$	6400	10	$\frac{11}{16}$	1600	20	1	800
3	$\frac{3}{8}$	5333	12	$\frac{3}{4}$	1333	22	$1\frac{1}{16}$	727

RAILROAD SPIKES.

Size Measured Under Head.	Average No. per keg of 200 lbs.	Ties two feet between centers, Four spikes per tie, Makes per Mile.	Rail used. Wt. per Yard.
5½x9/16	360	5870 lbs.—29⅓ kegs.	45 to 70
5 x9/16	400	5170 " —26 "	40 to 56
5 x½	450	4660 " —23⅓ "	35 to 40
4½x½	530	3960 " —20 "	28 to 35
4 x½	600	3520 " —17⅔ "	24 to 35
4½x7/16	680	3110 " —15½ "	20 to 30
4 x7/16	720	2940 " —14¾ "	
3½x7/16	900	2350 " —11¾ "	16 to 25
4 x⅜	1000	2090 " —10½ "	
3½x⅜	1190	1780 " — 9 "	16 to 20
3 x⅜	1240	1710 " — 8½ "	
2½x⅜	1342	1575 " — 7⅞ "	12 to 16

RAILS REQUIRED PER MILE

OF FOLLOWING WEIGHT PER YARD.

Weight per yard.	Tons of 2,240 lbs. per Mile.
16 lbs.	25 tons, 320 lbs.
20 "	31 " 960 "
25 "	39 " 640 "
28 "	44 " 0 "
30 "	47 " 320 "
35 lbs.	55 tons, 0 lbs.
40 "	63 " 1920 "
45 "	70 " 1600 "
56 "	88 " 0 "
60 "	94 " 640 "
65 "	102 " 320 "
70 "	110 " 0 "

CROSS TIES, PER MILE.

Center to Center.	No. Ties.
1½ Feet	3520
1¾ "	3017
2 "	2640
2¼ "	2348
2½ "	2113

SPLICE JOINTS, PER MILE.

Two Bars and Four Bolts and Nuts to each Joint.

Rails, 20 feet long, 528 joints.
" 24 " " 440 "
" 26 " " 406 "
" 28 " " 378 "
" 30 " " 352 "

Nails Required for Different Kinds of Work.

For 1,000 shingles, 3½ to 5 lbs. 4*d.* nails, or 3 to 3½ lbs. 3*d.*
1,000 laths, about 7 lbs. 3*d.* fine.
1,000 feet clapboards, about 18 lbs. 6*d.* box.
1,000 feet covering boards, about 20 lbs. 8*d.* common, or 25 lbs. 10*d.*
1,000 feet upper floors, square edged, about 38 lbs. 10*d.* floor, or 41 lbs. 12*d.* floor.
1,000 feet upper floors, matched and blind-nailed, 38 lbs. 10*d.*, or 42 lbs 12*d.* common.
10 feet partitions, studs or studding, 1 lb. 10*d.* common.
1,000 feet furring, 1 x 3, about 45 lbs. 10*d.* common.
1,000 feet furring, 1 x 2, about 65 lbs. 10*d.* common.
1,000 feet pine finish, about 30 lbs. 8*d.* finish.

USEFUL TABLES FOR PLUMBERS, ETC.

SIZES AND WEIGHTS OF LEAD PIPE.

CALIBRE.	Weight per foot. LBS.	OZ.
3/32 inch Tubing		1¼
⅛ inch Tubing		3
3/16 inch Tubing		4
¼ inch Tubing		6
Fish Seine		15
⅜ inch Aqueduct		8
Ex. Light		9
Light		12
Medium	1	
Strong	1	8
Ex. Strong	2	
½ inch Aqueduct		10
Ex. Light		12
Light	1	
Medium	1	4
Strong	1	12
AA	2	
Ex. Strong	2	8
Ex. Ex. Strong	3	
⅝ inch Aqueduct		12
Ex. Light	1	4
Light	1	12
Medium	2	
Strong	2	8
Ex. Strong	3	
Ex. Ex. Strong	3	8
¾ inch Aqueduct	1	
Ex. Light	1	8
Light	2	
Medium	2	4
Strong	3	
Ex. Strong	3	8
Ex. Ex. Strong	4	
⅞ inch Aqueduct	1	8
Ex. Light	2	
Light	2	8
Medium	3	
Strong	3	8
1 inch Aqueduct	1	8
Ex. Light	2	
Light	2	8
Medium	3	4
Strong	4	
Ex. Strong	4	12
Ex. Ex. Strong	5	8
1¼ inch Aqueduct	2	
Ex. Light	2	8
Light	3	
Medium	3	12

CALIBRE.	Weight per foot. LBS.	OZ.
1¼ inch Strong	4	12
Ex. Strong	6	
Ex. Ex. Strong	6	12
1½ inch Aqueduct	3	
Ex. Light	3	8
Light	4	
Medium	5	
Strong	6	
Ex. Strong	7	8
Ex. Ex. Strong	9	
1¾ inch Ex. Light	3	12
Light	4	8
Medium	5	8
Strong	6	8
Ex. Strong	8	
2 inch Waste	3	
Ex. Light	4	
Light	5	
Medium	7	
Strong	8	
Ex. Strong	9	
Ex. Ex. Strong	10	8
2½ inch Waste	4	
Light	6	
3/16 thick	8	
¼ thick	11	
5/16 thick	14	
⅜ thick	17	
3 inch Waste	3	
Waste	3	12
Light	5	
3/16 thick	9	
¼ thick	12	
5/16 thick	16	
⅜ thick	20	
3½ inch Waste	5	
¼ thick	15	
5/16 thick	18	
4 inch Waste	5	
Waste	6	
Waste	8	
Waste	10	
¼ thick	16	
5/16 thick	21	
⅜ thick	25	
4½ inch Waste	6	
5 inch Waste	8	
6 inch Waste	10	

SEEST thou a man diligent in his business? He shall stand before kings; he shall not stand before mean men.—OLD TESTAMENT.

SIZES AND WEIGHTS OF PURE BLOCK TIN PIPE.

3-16 in.	4 oz.		3/4 in.	7 oz. and	12 oz.
1/4 "	4 oz. and	6 oz.	1 "	12 " "	16 "
5-16 "	5 " "	8 "	1 1/4 "	1 1/4 lb. and	1 3/4 lb.
3/8 "	4 " "	6 "	1 1/2 "	1 1/2 " "	2 "
1/2 "	6 " "	8 "	2 "	2 " "	3 "
5/8 "	9 " "	12 "			

WEIGHT PER SQUARE FOOT OF SHEET LEAD.

1-32 in. thick	2 lbs.	1-10 in. thick	7 lbs.
3-64 " "	2 1/2 "	1/8 " "	8 "
1-25 " "	3 "	5-32 " "	10 "
1-16 " "	4 "	3-16 " "	12 "
1-14 " "	5 "	7-32 " "	14 "
1-12 " "	6 "	1/4 " "	16 "

WEIGHT PER JOINT OF LEAD AND GASKET FOR STREET MAINS.

	Lead.	Gasket.		Lead.	Gasket.
2-inch Pipe,	3.25 lbs.,	0.050 lbs.	10-inch Pipe,	15 lbs.,	0.30 lbs.
3-inch "	4.72 "	0.075 "	12-inch "	20 "	0.35 "
4-inch "	6. "	0.115 "	16-inch "	25 "	0.45 "
6-inch "	9. "	0.175 "	18-inch "	29 "	0.52 "
8-inch "	12. "	0.250 "	20-inch "	43 "	0.60 "

CAPACITY OF DRAIN-PIPE.

Size of Pipe.	Gallons Per Minute.							
	1/2 in. Fall per 100 feet.	3-in. Fall per 100 feet.	6-in. Fall per 100 feet.	9-in. Fall per 100 feet.	12-in. Fall per 100 feet.	18-in. Fall per 100 feet.	24-in. Fall per 100 feet.	36-in. Fall per 100 feet.
3-inch.	21	30	42	52	60	74	85	104
4 "	36	52	76	92	108	132	148	184
6 "	84	120	169	206	240	294	338	414
9 "	232	330	470	570	660	810	930	1140
12 "	470	680	960	1160	1360	1670	1920	2350
15 "	830	1180	1680	2040	2370	2920	3340	4100
18 "	1300	1850	2630	3200	3740	4600	5270	6470
20 "	1760	2450	3450	4180	4860	5980	6850	8410

The maximum rainfall is about one inch per hour (except during very heavy storms)—equal to 22,633 gallons an hour for each acre, or 377 gallons a minute per acre.

AVOID shame, but do not seek glory—nothing so expensive as glory.—SIDNEY SMITH.

THAT this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, for the people, shall not perish from the earth.—ABRAHAM LINCOLN.

Rules for Obtaining Approximate Weight of Cast Iron.

Square of diameter multiplied by 2.46 equals weight of cast iron round bar 1 foot long.

To ascertain weight of cast iron columns or pipe subtract weight of inside diameter of shell from weight of outside diameter.

Square of the diameter divided by 5 equals approximately the weight of a circular cast iron plate 1 inch thick.

Rules for Obtaining Approximate Weight of Wrought Iron.

FOR ROUND BARS—*Rule:* Multiply the square of the diameter in inches by the length in feet, and that product by 2.6. The product will be the weight in pounds, nearly.

FOR SQUARE AND FLAT WROUGHT BARS—*Rule:* Multiply the area of the end of the bar in inches by the length in feet, and that by 3.32. The product will be the weight in pounds, nearly.

To find the sectional area of a bar of wrought iron, given the weight per foot, multiply by 3 and divide by 10.

To find the weight per foot, given the area, divide by 3 and multiply by 10.

To Convert Weight of

Wrought Iron into Cast Iron	× 0.928
" " " Steel	× 1.014
" " " Zinc	× 0.918
" " " Brass	× 1.082
" " " Copper	× 1.144
" " " Lead	× 1.468
Square Iron into Round	× .7854

Decimal Approximations Useful in Calculations,

Cubic inches,	× .267	=	lbs.	average	cast iron.
" "	× .281	=	"	"	wrought iron.
" "	× .283	=	"	"	cast steel.
" "	× .3225	=	"	"	copper.
" "	× .3037	=	"	"	brass.
" "	× .26	=	"	"	zinc.
" "	× .4103	=	"	"	lead.
" "	× .2636	=	"	"	tin.
" "	× .4908	=	"	"	mercury.
Cylin. "	× .2065	=	"	"	cast iron.
" "	× .2168	=	"	"	wrought iron.
" "	× .2223	=	"	"	cast steel.
" "	× .2533	=	"	"	copper.
" "	× .2385	=	"	"	brass.
" "	× .2042	=	"	"	zinc.
" "	× .3223	=	"	"	lead.
" "	× .207	=	"	"	tin.
" "	× .3854	=	"	"	mercury.

Weight of a Lineal Foot of Flat Bar Iron, in Lbs.

BIRMINGHAM GAUGE.

Breadth in Inches.	Thickness in Fractions of Inches.								
	¼	5-16	⅜	7-16	½	⅝	¾	⅞	1
1	.83	1.04	1.25	1.46	1.67	2.08	2.50	2.92	3.34
1⅛	.93	1.17	1.40	1.64	1.87	2.34	2.81	3.28	3.75
1¼	1.04	1.30	1.56	1.82	2.08	2.60	3.13	3.65	4.17
1⅜	1.14	1.43	1.72	2.00	2.29	2.87	3.44	4.01	4.59
1½	1.25	1.56	1.87	2.19	2.50	3.13	3.75	4.38	5.00
1⅝	1.35	1.69	2.03	2.37	2.71	3.39	4.07	4.70	5.43
1¾	1.46	1.82	2.19	2.55	2.92	3.65	4.38	5.11	5.84
1⅞	1.56	1.95	2.34	2.74	3.13	3.91	4.69	5.47	6.26
2	1.67	2.08	2.50	2.92	3.34	4.17	5.01	5.86	6.68
2⅛	1.77	2.21	2.66	3.10	3.55	4.43	5.32	6.21	7.10
2¼	1.87	2.34	2.81	3.28	3.76	4.69	5.63	6.57	7.52
2⅜	1.98	2.47	2.97	3.47	3.96	4.95	5.95	6.94	7.93
2½	2.08	2.60	3.13	3.65	4.17	5.21	6.26	7.30	8.35
2⅝	2.19	2.74	3.28	3.83	4.38	5.47	6.57	7.67	8.77
2¾	2.29	2.87	3.44	4.01	4.59	5.74	6.88	8.03	9.18
2⅞	2.40	3.00	3.60	4.20	4.80	6.00	7.20	8.40	9.60
3	2.50	3.13	3.75	4 38	5.01	6.26	7.51	8.76	10.02
3¼	2.71	3.39	4.07	4.74	5.43	6.78	8.14	9.49	10.86
3½	2.92	3.65	4.38	5.11	5.84	7.30	8.76	10.23	11.69
3¾	3.13	3.91	4.68	5.47	6.26	7.82	9.39	10.95	12.52
4	3.34	4.17	5.00	5.84	6.68	8.35	10.02	11.69	13.36
4¼	3.54	4.43	5.32	6.21	7.09	8.87	10.64	12.42	14.19
4½	3.75	4.69	5.63	6.57	7.51	9.39	11.27	13.15	15.03
4¾	4.06	4.95	5.94	6.94	7.93	9.91	11.89	13.83	15.86
5	4.17	5.21	6.26	7.30	8.35	10.44	12.52	14.61	16.70
5¼	4.38	5.47	6.57	7.67	8.76	11.06	13.14	15.34	17.53
5½	4.59	5.73	6.88	8.03	9.18	11.48	13.77	16.07	18.37
5¾	4.80	6.00	7.20	8.40	9.60	12.00	14.40	16.80	19.20
6	5.01	6.25	7.51	8.76	10.02	12.53	15.03	17.53	20.05

Wrought Iron, Assumed Weight.

A cubic foot	= 480	lbs.
A square foot, 1 inch thick	= 40	"
A bar 1 inch square, 1 foot long	= 3⅓	"
A " 1 " " 1 yard long . . .	= 10	"

GAUGES AND THEIR EQUIVALENTS.

No. 27, equal to	$\frac{1}{64}$ inch.	No. 12, equal to	$\frac{7}{64}$ inch.
" 21, " "	$\frac{1}{32}$ "	" 10, " "	⅛ "
" 18, " "	$\frac{3}{64}$ "	" 8, " "	$\frac{11}{64}$ "
" 16, " "	$\frac{1}{16}$ "	" 6, " "	$\frac{3}{16}$ "
" 14, " "	$\frac{5}{64}$ "	" 5, " "	$\frac{7}{32}$ "
" 13, " "	$\frac{3}{32}$ "	" 4, " "	¼ "

Truth is as impossible to be soiled by any outward touch as the sunbeam.—*Lord Bacon.*

AMERICAN AND BIRMINGHAM WIRE GAUGES.

THICKNESS IN INCHES.

Haswell.

Gauge.	Thickness American Gauge.	Thickness Birmingham Gauge.	Gauge.	Thickness American Gauge.	Thickness Birmingham Gauge.
0000	.46	.454	17	.0452	.058
000	.4096	.425	18	.0403	.049
00	.3648	.38	19	.0359	.042
0	.3248	.34	20	.0319	.035
1	.2893	.30	21	.0284	.032
2	.2576	.284	22	.0253	.028
3	.2294	.259	23	.0225	.025
4	.2043	.238	24	.0201	.022
5	.1819	.22	25	.0179	.02
6	.1620	.203	26	.0160	.018
7	.1443	.18	27	.0142	.016
8	.1285	.165	28	.0126	.014
9	.1144	.148	29	.0112	.013
10	.1019	.134	30	.01	.012
11	.0907	.12	31	.0089	.01
12	.0808	.109	32	.0079	.009
13	.0719	.095	33	.007	.008
14	.0641	.083	34	.0063	.007
15	.057	.072	35	.0056	.005
16	.0508	.065	36	.005	.004

The Area of a Circle.

Of all plane figures, the circle is the most capacious, or has the greatest area within the same limits. It is geometrically demonstrable that it has the same area as a right-angled triangle with a base equal to its circumference, and a perpendicular equal to its radius, that is, half the product of the radius and circumference. It is obviously larger than any figure, of however many sides, inscribed within its perimeter, and smaller than any circumscribed polygon. As a result of laborious calculations on this basis (pushed in one instance to 600 places of decimals without reaching the end), it has been ascertained that the ratio of the diameter to the circumference of any circle (sufficient) exact for all practical purposes), is as 1 : 3.1416 (3.141592653+) or in whole numbers, approximately, as 7 : 22, or more nearly as 113 : 355. Hence, to find the circumference or diameter, the other quantity being known, multiply or divide by 3.1416; and to find the area, multiply half the diameter by half the circumference, or the square of the diameter by .7854 (3.1416÷4).

To FIND THE SURFACE OF A GLOBE, multiply the square of the diameter by 3.1416.

To FIND THE SOLIDITY OF A GLOBE, multiply the cube of the diameter by .5236.

Table of Transmission of Power by Wire Ropes.

Diameter of Wheel in Ft.	Number of Revolutions.	Trade No. of Rope.	Diameter of Rope.	Horse Power.
4	80	23	3/8	3.3
4	100	23	3/8	4.1
4	120	23	3/8	5.0
4	140	23	3/8	5.8
5	80	22	7/16	6.9
5	100	22	7/16	8.6
5	120	22	7/16	10.3
5	140	22	7/16	12.1
6	80	21	1/2	10.7
6	100	21	1/2	13.4
6	120	21	1/2	16.1
6	140	21	1/2	18.7
7	80	20	9/16	16.9
7	100	20	9/16	21.1
7	120	20	9/16	25.3
7	140	20	9/16	29.6
8	80	19	5/8	22.0
8	100	19	5/8	27.5
8	120	19	5/8	33.0
8	140	19	5/8	38.5
9	80	20 19	9/16 5/8	40.0 41.5
9	100	20 19	9/16 5/8	50.0 51.9
9	120	20 19	9/16 5/8	60.0 62.2
9	140	20 19	9/16 5/8	70.0 72.6

Diameter of Wheel in Ft.	Number of Revolutions.	Trade No. of Rope.	Diameter of Rope.	Horse Power.
10	80	19 18	5/8 11/16	55.0 58.4
10	100	19 18	5/8 11/16	68.7 73.0
10	120	19 18	5/8 11/16	82.5 87.6
10	140	19 18	5/8 11/16	96.2 102.2
11	80	19 18	5/8 11/16	64.9 75.5
11	100	19 18	5/8 11/16	81.1 94.4
11	120	19 18	5/8 11/16	97.3 113.3
11	140	19 18	5/8 11/16	113.6 132.1
12	80	18 17	11/16 3/4	93.4 99.3
12	100	18 17	11/16 3/4	116.7 124.1
12	120	18 17	11/16 3/4	140.1 148.9
12	140	18 17	11/16 3/4	163.5 173.7
13	80	18 17	11/16 3/4	112.0 122.6
13	100	18 17	11/16 3/4	140.0 153.2
13	120	18 17	11/16 3/4	168.0 183.9
14	80	17 16	3/4 7/8	148.0 141.0
14	100	17 16	3/4 7/8	185.0 176.0
14	120	17 16	3/4 7/8	222.0 211.0
15	80	17 16	3/4 7/8	217.0 217.0
15	100	17 16	3/4 7/8	259.0 259.0
15	120	17 16	3/4 7/8	300.0 300.0

COMPARATIVE LIST OF PLANES.

Chapin	San-dusky.	Ohio.	Au-burn.	Sar-gent.	Descrip-tion.	Chapin	San-dusky.	Ohio.	Au-burn.	Sar-gent.	Description	Chapin	San-dusky.	Ohio.	Au-burn.	Sar-gent.	Description
100	....	....	....	600	Smooth.	148	67	53	119	648	Filletster	217¾	54¾	43⅛	155½	717¾	Casing
101	....	....	....	601	Jack	149	68	54	120	649	"	219	53	43	156	719	Cove.
104	1	1	1	604	Smooth.	150	69	55	121	650	"	230	116	94	87	730	Plow.
105	10	12	9	605	Jack.	151	....	....	....	651	"	232	117	95	89	732	"
108	....	....	....	608	Smooth.	155	150	120	181	655	Rabbet.	234	119	96½	90	734	"
109	....	....	....	609	Jack.	157	146	116	181	657	"	235	120	97	90½	735	"
110	....	....	....	610	Fore.	159	149	119	53	659	"	236	123	100	92	736	"
111	....	....	....	611	Jointer.	160	149	119	51	660	"	238	124	101	94	738	"
112	3	3	3	612	Smooth.	163	92	72	180	663	Hollow & Round.	243	121	98	91	743	"
112½	5	5	7	612½	"	167	94	73	180	663	" "	400	....	....	....	900	Smooth.
113	13	15	12	613	Jack.	171	99	75	69	671	Match.	401	....	....	....	901	Jack.
113½	15	17	16	613½	"	172	100	76	70	672	"	402	....	....	....	902	Fore.
114	19	21	20	614	Fore.	173	99 & 99½	....	....	673	"	404	....	....	....	904	Smooth.
114½	21	23	24	614½	"							405	....	....	....	905	Jack.
115	25	27	30	615	Jointer.	174	....	....	....	674	"	406	....	....	....	906	Fore.
115½	27	29	37	615½	"	175	101	77	73	675	"	411	28	....	55	911	Smooth.
123	47	37	105	623	Bead.	176	102	78	74	676	"	412	30	....	56	912	Jack.
124	48	38	106	624	"	178	104	80	76	678	"	413	31	....	57	913	Fore.
126	51	41	108	626	"	181	106	82	80	681	"	423	....	....	....	923	Ship Smooth.
128	152	122	182	628	Reeding.	182	106½	84	81	682	"	424	....	....	....	924	" Jack.
132	111	90	189	632	Nosing.	204	74	59	128	704	Ogee	425	....	....	....	925	" Fore.
133	113	91	189	633	"	207	96	140	125	707	"	426	....	....	....	926	" Jointer
133½	114	92	189	633½	"	207½	82½	62¼	....	707½	"	427	....	....	....	927	Spar.
138	60	47	176	638	Dado.	208	77	60	140	708	"	430	36	30	190	930	Tooth.
139	62	48	177	639	"	209	79	61	144	709	"	431	38	31 A	46	931	Mitre
146	65	51	117	646	Filletster.	209	78	....	142	709½	"	432	38½	31	47	932	"
147	66	52	118	647	"	217	54	43½	155	717	Ovolo.	434	39	31¼	49	934	"

COMPARATIVE LIST OF RULES.

Stanley.	Stephens.	Chapin.	Stanley.	Stephens.	Chapin.	Stanley.	Stephens.	Chapin.	Stanley.	Stephens.	Chapin.	Stanley.	Stephens.	Chapin.
1	13	41	39	98½	76	54	49	19	65	71	2	81	66	36
4	15	44	40	99¼	77	55	73	6	65½	72½	5	82	67	37
5	17	45	41	111	83	56	74	7	66	32	84	83	..	33
12	14	48	42	31	85	57	75	9	67	53	22	84	42¼	14
15	27	49	43½	...	90½	58	33	96	68	41	10	85	77	59
18	2	39	44	...	92	59	50	20	69	70	1	86	83	60
26	9	46	45	...	93	60	52	21	70	54	23	87	84	61
29	1	38	48	...	89	61	42	11	72	56	24	88	94	57
32	98	72	49	...	90¾	61½	44	11½	72½	54½	26	89	86	62
32½	99	73	50	112	98	62	42½	15	73	57	27	90	89	52
34	124	80	51	46	16	62½	42¾	15⅝	75	59	28	92	91	55
36	95	70	52	49¼	18	63	45	12	76	60	30	92½	90½	54
36½	100	70½	53	48	17	63½	44½	13	77	61	31	..		..
38	95½	74	53½	39	17½	64	72	3	78½	63	32	..		..

COMPARATIVE LIST OF PADLOCKS.

R. & E.	M.W.&CO.	S. & CO.	W. W. Mfg. Co
5000	5/0	120	4/0
4000	4/0	100	5/0
2000	3/0	200	3/0
200	2/0	201	2/0
201	0	202	0
202	1	301	1
203	2	302	2
204	3	303	3
205	4	315	4
206	5	316	5
207	6	365	6
208	7	605	7
211	8	715	8
209	9	346	9
210	10	762	10
212	11	815	11
213	12	369	12
313	13	369c	13
314	14	347c	14
301	16	202c	16
306	17	316c	17
280	80	716	80
1200	1000	204	303c
1212	1007	816	....
1210	1013	706	....
225	1015	336	....
232	1016	619	....
230	1017	411	3067
1209	1020	349	....
220	1021	203	3013
221	1022	313	369
215	1023	304	3028
226	1025	335	3064
214	1026	312	57
1222	....	222	....
1036	1029	215	3001
1032	1030	385	3017
1206 & 1232	1031	307 & 386	3002 & 3014
1309	1032	385c	3006 & 3015
1233	1033	404	3026
1234	1034	408	3021
1001	1037	122	3011
1227	1038	607	....
326	1042	335c	3065 & 3032
1237	1043	223	3027
1347	1044	232c	3066
1345	1043	405c	3070
1346	1046	409c	....
246	1048	321	3036
346	1049	321c	3034
247	1050	325	....
347	1051	325c	....
1231 & 1241	1052	216	3040
1247	1053	232	3044
1245	1054	405	3042
1246	1055	409	3043
216	1056	402	3048
243	1057	406	....
1225	1058	403	....
1322	1000	216c	....
1241	1063	218	3018
1209	1065	363 & 348	3039
1203	1077	305	3400

Weight per Lineal Foot.

$\frac{3}{8}$	inch	diameter	.4256 lbs.
$\frac{7}{16}$	"	"	.5794 "
$\frac{1}{2}$	"	"	.7567 "
$\frac{9}{16}$	"	"	.9578 "
$\frac{5}{8}$	"	"	1.1824 "
$\frac{11}{16}$	"	"	1.4307 "
$\frac{3}{4}$	"	"	1.7027 "
$\frac{13}{16}$	"	"	1.9982 "
$\frac{7}{8}$	"	"	2.3176 "
$\frac{15}{16}$	"	"	2.6605 "
1	"	"	3.0270 "
$1\frac{1}{8}$	"	"	3.8312 "
$1\frac{1}{4}$	"	"	4.7228 "
$1\frac{3}{8}$	"	"	5.7228 "
$1\frac{1}{2}$	"	"	6.8109 "
$1\frac{5}{8}$	"	"	7.9931 "
$1\frac{3}{4}$	"	"	9.2702 "
$1\frac{7}{8}$	"	"	10.6420 "
2	"	"	12.1082 "
$2\frac{1}{4}$	"	"	15.3251 "
$2\frac{1}{2}$	"	"	18.9161 "
$2\frac{3}{4}$	"	"	22.8913 "
3	"	"	27.2435 "
$3\frac{1}{4}$	"	"	31.9722 "
$3\frac{1}{2}$	"	"	37.0808 "
$3\frac{3}{4}$	"	"	42.5680 "
4	"	"	48.4330 "

A Brazier Sheet (30x60 inches) contains 12½ square feet (1800 square inches).

When	it is	8 oz.	per	square	foot	it weighs	6¼	lbs.
"	"	$10^{24}/_{100}$	"	"	"	"	8	"
"	"	$12^{80}/_{100}$	"	"	"	"	10	"
"	"	$15^{36}/_{100}$	"	"	"	"	12	"
"	"	16	"	"	"	"	12½	"

TO ASCERTAIN THE WEIGHT OF ROLLED COPPER.

Find the number of cubic inches in the piece, multiply by 0.3229, and the product will be the weight in pounds.

Or, multiply the length and breadth (in feet) and that by the pounds per square foot.

Has specific gravity of 8.93. One cubic foot weighs $558^{125}/_{1000}$ pounds. One square foot, of one inch thick, weighs $46^{51}/_{100}$ pounds.

Ounces per Square Foot.	Sheets, 14x48, Weight in Lbs.	Sheets, 24x48, Weight in Lbs.	Sheets, 30x60, Weight in Lbs.	Sheets, 36x72, Weight in Lbs.	Sheets, 48x72, Weight in Lbs.	Thickness in Decimal Parts of One Inch.	Stubbs' Gauge, (Nearest) No.
4	1.16	2	3.12	4.50	6	.00537	35
6	1.75	3	4.68	6.75	9	.00806	33
8	2.33	4	6.25	9.	12	.0107	31
10	2.91	5	7.81	11.25	15	.0134	29
12	3.50	6	9.37	13.50	18	.0161	27
14	4.08	7	10.93	15.75	21	.0188	26
16	4.66	8	12.50	18.	24	.0215	24
18	5.25	9	14.06	20.25	27	.0242	23
20	5.83	10	15.62	22.50	30	.0269	22
24	7.	12	18.75	27	36	.0322	21
32	9.33	16	25.	36	48	.0430	19
40	11.66	20	31.25	45	60	.0538	18
48	14.	24	37.50	54	72	.0645	16
56	16.33	28	43.75	63	84	.0754	15
64	18.66	32	50	72	96	.0860	14
70		35	55	79	105	.095	13
81		40½	63	91	122	.109	12
89		44½	70	100	134	.120	11
100		50	78	112	150	.134	10
110		55	86	124	165	.148	9
123		61	96	138	184	.165	8
134		67	105	151	201	.180	7
151		75½	118	170	227	.203	6
164		82	128	184	246	.220	5
177		88½	138	199	266	.238	4
193		96	151	217	289	.259	3
211		105½	165	238	317	.284	2
223		111½	174	251	336	.300	1
253		126½	198	285	380	.340	0

Weight of Copper and Brass Wire.

Diameters Determined by American Gauge.

No. of Gauge	Size of each No.	Weight of Wire per 1000 Lineal Feet: Wrought Iron	Steel	Copper	Brass
	Inch	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
0000	.46000	560.74	566.03	640.51	605.18
000	.40964	444.68	448.88	507.95	479.91
00	.36480	352.66	355.99	402.83	380.67
0	.32486	279.67	282.30	319.45	301.82
1	.28930	221.79	223.89	253.34	239.35
2	.25763	175.89	177.55	200.91	189.82
3	.22942	139.48	140.80	159.32	150.52
4	.20431	110.62	111.66	126.35	119.38
5	.18194	87.720	88.548	100.20	94.666
6	.16202	69.565	70.221	79.462	75.075
7	.14428	55.165	55.685	63.013	59.545
8	.12849	43.751	44.164	49.976	47.219
9	.11443	34.699	35.026	39.636	37.437
10	.10189	27.512	27.772	31.426	29.687
11	.090742	21.820	22.026	24.924	23.549
12	.080808	17.304	17.468	19.766	18.676
13	.071961	13.722	13.851	15.674	14.809
14	.064084	10.886	10.989	12.435	11.746
15	.057068	8.631	8.712	9.859	9.315
16	.050820	6.845	6.909	7.819	7.587
17	.045257	5.427	5.478	6.199	5.857
18	.040303	4.304	4.344	4.916	4.645
19	.035890	3.413	3.445	3.899	3.684
20	.031961	2.708	2.734	3.094	2.920
21	.028462	2.147	2 167	2.452	2.317
22	.025347	1.703	1.719	1.945	1.838
23	.022571	1.350	1.363	1.542	1.457
24	.020100	1.071	1.081	1.223	1.155
25	.017900	.8491	.8571	.9699	.9163
26	.01594	.6734	.6797	.7692	.7267
27	.014195	.5340	.5391	.6099	.5763
28	.012641	.4235	.4275	.4837	.4570
29	.011257	.3358	.3389	.3835	.3624
30	.010025	.2663	.2688	.3042	.2874
31	.008928	.2113	.2132	.2413	.2280
32	.007950	.1675	.1691	.1913	.1808
33	.007080	.1328	.1341	.1517	.1434
34	.006304	.1053	.1063	.1204	.1137
35	.005614	.08366	.08445	.0956	.09015
36	.005000	.06625	.06687	.0757	.0715
37	.004453	.05255	.05304	.06003	.05671
38	.003965	.04166	.04205	.04758	.04496
39	.003531	.03305	.03336	.03755	.03566
40	.003144	.02620	.02644	.02992	.02827
Specific Gravity		7.7747	7.848	8.880	8.386
Weight per Cubic Foot..		485.874	490.45	554.988	524.16

WEIGHTS PER SQUARE FOOT OF

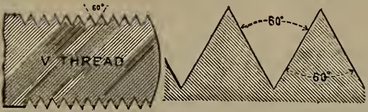
SHEET WROUGHT IRON, STEEL, COPPER AND BRASS.

For Thickness by American (Brown & Sharpe's) Gauge.

No. of Gauge.	Thickness in Inches.	Iron.	Steel.	Copper.	Brass.
0000	.46	18.46	18.70	20.84	19.69
000	.4096	16.44	16.66	18.56	17.53
00	.3648	14.64	14.83	16.53	15.61
0	.3249	13.04	13.21	14.72	13.90
1	.2893	11.61	11.76	13.11	12.38
2	.2576	10.34	10.48	11.67	11.03
3	.2294	9.21	9.33	10.39	9.82
4	.2043	8.20	8.31	9.26	8.74
5	.1819	7.30	7.40	8.24	7.79
6	.1620	6.50	6.59	7.34	6.93
7	.1443	5.79	5.87	6.54	6.18
8	.1285	5.16	5.22	5.82	5.50
9	.1144	4.59	4.65	5.18	4.90
10	.1019	4.09	4.14	4.62	4.36
11	.0907	3.64	3.69	4.11	3.88
12	.0808	3.24	3.29	3.66	3.46
13	.0720	2.89	2.93	3.26	3.08
14	.0641	2.57	2.61	2.90	2.74
15	.0571	2.29	2.32	2.59	2.44
16	.0508	2.04	2.07	2.30	2.18
17	.0453	1.82	1.84	2.05	1.94
18	.0403	1.62	1.64	1.83	1.73
19	.0359	1.44	1.46	1.63	1.54
20	.0320	1.28	1.30	1.45	1.37
21	.0285	1.14	1.16	1.29	1.22
22	.0253	1.02	1.03	1.15	1.08
23	.0226	.906	.918	1.02	.966
24	.0201	.807	.817	.911	.860
25	.0179	.718	.728	.811	.766
26	.0159	.640	.648	.722	.682
27	.0142	.570	.577	.643	.608
28	.0126	.507	.514	.573	.541
29	.0113	.452	.458	.510	.482
30	.0100	.402	.408	.454	.429
31	.0089	.358	.363	.404	.382
32	.0080	.319	.323	.360	.340
33	.0071	.284	.288	.321	.303
34	.0063	.253	.256	.286	270
35	.0056	.225	.228	.254	240
Specific gravity, ...		7.704	7.806	8.698	8.218
Weight per cubic inch,		.2787	.2823	.3146	.2972
Weight per cubic foot,		481.25	487.75	543.60	513.60

FORMS OF THREADS.

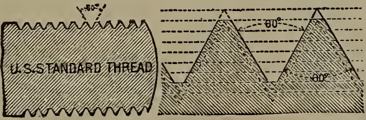
V THREAD.



Sizes............	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
No. Threads.....	20	18	16	14	12	11	10	9	8	7	7	6	6	5	5	4 1/2	4 1/2

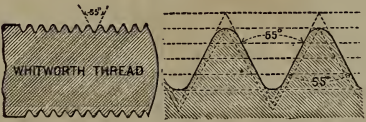
This form and number of threads supplied, unless otherwise ordered. (Frequently 1/32 over exact size, for rough iron.)

U. S. FRANKLIN INST. OR SELLERS' THREAD.



Sizes.........	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
No. Threads...	20	18	16	14	13	12	11	10	9	8	7	7	6	6	5 1/2	5	5	4 1/2

WHITWORTH (ENGLISH) STANDARD THREAD.

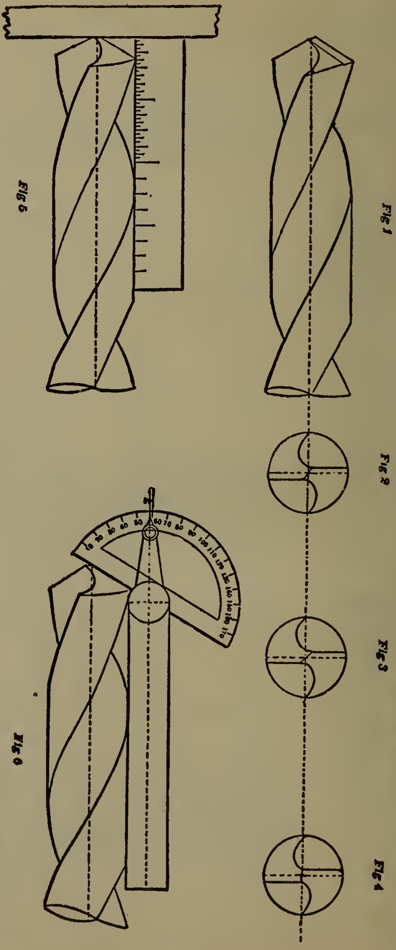


Sizes............	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
No. Threads......	20	18	16	14	12	11	10	9	8	7	7	6	6	5	5	4 1/2	4 1/2

GRINDING

Twist Drills.

Few operations on tools in the shop are more frequently disappointing than the grinding or sharpening of drills. That the cutting edges have a proper and uniform angle with the longitudinal axis of the drill, (see Fig. 6,) having them of exactly equal length, and the lips of the drill well and sufficiently backed off or cleared, are points generally understood as requisite to the satisfactory performance of a drill, though not always attained. Practical suggestions for the grinding of drills have been published from time to time. We append in part from these, hoping they will be found useful. "If the clearance of a drill is insufficient or imperfect it will not cut. When force is applied it resists the power of the drilling machine, and is crushed or split. It is well to start a drill, after grinding by hand, observing the character of the chips, which should characterize a clean cutting tool. In wrought metal the chip will sometimes attain a length of several feet. Prof. Sweet suggests that the rear of the lip of a drill be removed, as shown by the cut, No. 1; this makes the cutting edge much like a flat drill. Drills properly made have their



SPEED OF DRILLS.

The following table shows the revolutions per minute for Drills from $\frac{1}{16}$ in. to 2 in. diameter, as usually applied.

Diameter of Drills.	Speed for Wrought Iron and Steel.	Speed for Cast Iron.	Speed for Brass.	Diameter of Drills.	Speed for Wrought Iron and Steel.	Speed for Cast Iron.	Speed for Brass.
$\frac{1}{16}$ in.	1712	2383	3544	$1\frac{1}{16}$ in.	72	108	180
$\frac{1}{8}$ "	855	1191	1772	$1\frac{1}{8}$ "	68	102	170
$\frac{3}{16}$ "	571	794	1181	$1\frac{3}{16}$ "	64	97	161
$\frac{1}{4}$ "	397	565	855	$1\frac{1}{4}$ "	58	89	150
$\frac{5}{16}$ "	318	452	684	$1\frac{5}{16}$ "	55	84	143
$\frac{3}{8}$ "	265	377	570	$1\frac{3}{8}$ "	53	81	136
$\frac{7}{16}$ "	227	323	489	$1\frac{7}{16}$ "	50	77	130
$\frac{1}{2}$ "	183	267	412	$1\frac{1}{2}$ "	46	74	122
$\frac{9}{16}$ "	163	238	367	$1\frac{9}{16}$ "	44	71	117
$\frac{5}{8}$ "	147	214	330	$1\frac{5}{8}$ "	40	66	113
$\frac{11}{16}$ "	133	194	300	$1\frac{11}{16}$ "	38	63	109
$\frac{3}{4}$ "	112	168	265	$1\frac{3}{4}$ "	37	61	105
$\frac{13}{16}$ "	103	155	244	$1\frac{13}{16}$ "	36	59	101
$\frac{7}{8}$ "	96	144	227	$1\frac{7}{8}$ "	33	55	98
$\frac{15}{16}$ "	89	134	212	$1\frac{15}{16}$ "	32	53	95
1 "	76	115	191	2 "	31	51	92

One inch to be drilled in soft cast iron will usually require: For $\frac{1}{4}$ in. Drill, 160 revolutions; for $\frac{1}{2}$ in. Drill, 140 revolutions; for $\frac{3}{4}$ in. Drill, 100 revolutions; for 1 in. Drill, 95 revolutions.

GRINDING TWIST DRILLS—Continued

cutting edges straight when ground to a proper angle, which is 59°, as shown in cut No. 6. Grinding to less angle leaves the lip hooking, and is likely to produce a crooked and irregular hole. The grinding lines to a drill are placed slightly above the center. to allow for the proper angle of point, which is an important factor. This angle is an index to the clearance. If the angle is too much, the drill cuts rank; if not enough, the drill may not cut. Fig. 2 shows a proper angle. In Fig. 3 the angle is too sharp. In Fig. 4 the angle runs backward, and shows the want of clearance. An effective method of determining the clearance is to set the point of the drill on a plane surface, holding a scale as shown in cut No. 5; by revolving the drill its clearance is shown, as well as the height of the cutting lips, which should be equal; also the cutting edges should be of exactly equal length,—any inequality of lengths doubles itself in work. To strengthen the drill, the center is made thicker towards the shank. As the drill is shortened through use, the center shows thicker, and will work hard in drilling. To overcome this, the center should be thinned, care being taken to remove an equal amount of stock on each side, and so keep the point central. In grinding a drill preserve the original form, which usually will insure rapid and satisfactory work."

DRILL LIST

FOR

TAPS WITH "V" THREAD.

Diameter of Tap.	Threads per Inch.	Size of Drill.	Diameter of Tap.	Threads per Inch.	Size of Drill.	Diameter of Tap.	Threads per Inch.	Size of Drill.
3/32	48	49	13/32	16	P	31/32	9	13/16
3/32	56	48	13/32	18	21/64	1	8	53/64
3/32	60	47	7/16	14	R	1 1/32	8	55/64
7/64	32	49	7/16	16	S	1 1/16	8	57/64
7/64	36	48	15/32	14	3/8	1 3/32	8	59/64
7/64	40	46	15/32	16	W	1 1/8	7	59/64
1/8	32	44	1/2	12	25/64	1 1/8	8	61/64
1/8	36	42	1/2	13	X	1 5/32	7	61/64
1/8	40	41	1/2	14	13/32	1 5/32	8	63/64
9/64	30	40	17/32	12	27/64	1 3/16	7	63/64
9/64	32	38	17/32	13	27/64	1 3/16	8	1 1/64
9/64	36	37	17/32	14	7/16	1 7/32	7	1 1/64
5/32	30	33	9/16	12	29/64	1 7/32	8	1 3/64
5/32	32	32	9/16	14	15/32	1 1/4	7	1 3/64
5/32	36	31	19/32	12	31/64	1 9/32	7	1 5/64
3/16	24	29	19/32	14	1/2	1 5/16	7	1 7/64
3/16	30	26	5/8	10	31/64	1 11/32	7	1 9/64
3/16	32	27	5/8	11	1/2	1 3/8	6	1 1/8
7/32	24	20	5/8	12	13 m/m	1 13/32	6	1 5/32
7/32	30	16	21/32	10	33/64	1 7/16	6	1 3/16
7/32	32	14	21/32	11	17/32	1 15/32	6	1 7/32
1/4	18	17	21/32	12	35/64	1 1/2	6	1 17/64
1/4	20	14	3/4	10	39/64	1 17/32	6	1 19/64
1/4	24	8	3/4	11	5/8	1 5/8	5	1 21/64
9/32	18	13/64	3/4	12	16 m/m	1 21/32	5	1 23/64
9/32	20	3	25/32	10	41/64	1 3/4	5	1 29/64
5/16	16	I	25/32	11	16 1/2 m/m	1 25/32	5	1 31/64
5/16	18	C	25/32	12	17 m/m	1 13/16	5	1 33/64
5/16	20	E	13/16	10	43/64	1 27/32	5	1 35/64
11/32	16	F	27/32	10	45/64	1 7/8	4 1/2	1 35/64
11/32	18	17/64	7/8	9	23/32	1 29/32	4 1/2	1 37/64
3/8	14	K	7/8	10	47/64	1 15/16	4 1/2	1 39/64
3/8	16	M	29/32	9	3/4	1 31/32	4 1/2	1 41/64
3/8	18	19/64	29/32	10	49/64	2	4 1/2	1 43/64
13/32	14	N	15/16	9	25/32			

DRILL LIST

FOR TAPS WITH U. S. STANDARD THREADS.

1/4	20	3-16	7/8	9	47 64	1 7/8	5	1 5/8
5-16	18	D	1	8	27-32	2	4 1/2	1 23-32
3/8	16	N_m	1 1/8	7	61-64	2 1/8	4 1/2	1 27-32
7-16	14	9_m	1 1/4	7	1 5-64	2 1/4	4 1/2	1 31-32
1/2	13	13-32	1 3/8	6	1 11-64	2 3/8	4	2 1-16
9-16	12	29-64	1 1/2	6	1 19-64	2 1/2	4	2 3-16
5/8	11	33-64	1 5/8	5 1/2	1 25-64			
3/4	10	5/8	1 3/4	5	1 1/2			

MACHINE SCREW TAPS.

Size of Tap.	Size of Drill for Outside Diameter of Screw.	Size of Drill for Tapping Hole.	Size of Tap.	Size of Drill for Outside Diameter of Screw.	Size of Drill for Tapping Hole.	Size of Tap.	Size of Drill for Outside Diameter of Screw.	Size of Drill for Tapping Hole.
2x48		50	9x24		30	16x16		12
2x56	44	49	9x28		28	16x18	I	8
2x64		48	9x30	16	28	16x20		7
3x40		49	9x32		26	17x16		8
3x48	39	47	10x24		26	17x18	L	4
3x56		45	10x30	11	24	17x20		3
4x32		46	10x32		24	18x16		2
4x36	33	44	11x24		21	18x18	19-64	2
4x40		43	11x28	6	20	18x20		1
5x30		43	11x30		19	19x16		1
5x32		42	12x20		24	19x18	5-16	B
5x36	1/8	41	12x22		20	19x20		C
5x40		38	12x24	7-32	19	20x16		C
6x30		38	12x28		18	20x18	P	E
6x32		37	13x20		17	20x20		F
6x36	28	36	13x22	15-64	17	22x16	S	H
6x40		35	13x24		15	22x18		J
7x28		34	14x20		15	24x14		L
7x30	24	33	14x22	1/4	11	24x16	3/8	M
7x32		32	14x24		10	24x18		N
8x24		31	15x18		12	26x14	13-32	O
8x30	19	31	15x20		10	26x16		P
8x32		30	15x22	F	8	28x14	7-16	R
			15x24		7	28x16		S
						30x14	29-64	U
						30x16		V

29° SCREW THREAD.

ACME STANDARD.

The various parts of the 29° Screw Thread, Acme Standard are obtained as follows:

Width of Point of Tool for

$$\text{Screw or Tap Thread} = \frac{.3707}{\text{No. of Thd. per In.}} .0052$$

$$\text{Width of Screw or Nut Thd.} = \frac{.3707}{\text{No. of Thd. per In.}}$$

Diameter of Tap = Diameter of Screw + .020

Diameter of Tap or Screw at Root =

$$\text{Diameter of Screw} = \left(\frac{1}{\text{No of Linear Thd. per In.}} + .020\right)$$

$$\text{Depth of thread} = \frac{1}{2 \times \text{No. of Thds. per in.}} + .010$$

TABLE OF THREAD PARTS.

No. of Thds per in. Linear.	Depth of Thread.	Width at Top of Thread.	Width at Bottom of Thread.	Space at Top of Thread.	Thickness at Root of Thread.
1	.5100	.3707	3655	.6293	.6345
1 1-3	.3850	.2780	2728	.4720	.4772
2	.2600	.1853	.1801	.3147	.3199
3	.1767	.1235	.1183	.2098	.2150
4	.1350	.0927	.0875	.1573	.1625
5	.1100	.0741	.0689	.1259	.1311
6	.0933	.0618	.0566	.1049	.1101
7	.0814	.0529	.0478	.0899	.0951
8	.0725	.0463	.0411	.0787	.0839
9	0655	.0413	.0361	.0699	.0751
10	.0600	.0371	.0319	.0629	.0681

TABLES FOR USE WITH DRAUGHTSMEN'S PROTRACTORS.

Table for Dividing Circles or Laying out Geometrical Figures.

Number of Sides.	Included Angle	Angles at Center of Circles.	Angles for Sides of Figures.
3	120°	30°	30°
4	90°	45°	45°
5	72°	18°—54°	36°—72°
6	60°	30°	30°
8	45°	45°	22° 30′
10	36°	54°—18°	18°—54°
12	30°	60°	15°—45°
14	25° 43′	64° 17′—38° 34 12° 51′	12° 51′—38° 34′ 64° 17′
16	22° 30′	67° 30′—45°	11° 15′—33° 45′
18	20°	70°—50°—30° 10°	10°—30°—50° 70°
20	18°	72°—54°	9°—27°—45°
24	15°	75°—60°—45°	7° 30′—22° 30′ 37° 30′

Tapers per Foot and Corresponding Angles.

Taper Per Foot.	Included Angle.	Angle with Center Line	Taper Per Foot.	Included Angle.	Angle with Center Line
1-8″	0°—36′	0°—18′	1 ″	4°—46′	2°—23′
1-4″	1°—12′	0°—36′	1½″	7°—09′	3°—35′
5-16″	1°—30′	0°—45′	1¾″	8°—20′	4°—10′
3-8″	1°—17′	0°—54′	2 ″	9°—31′	4°—46′
7-16″	2°—05′	1°—02′	2½″	11°—54′	5°—57′
1-2″	2°—23′	1°—12′	3 ″	14°—15′	7°—08′
3-4″	3°—35′	1°—47′	3½″	16°—36′	8°—18′
15-16″	4°—28′	2°—14′	4 ″	18°—55′	9°—28′

DECIMAL EQUIVALENTS OF THE NUMBERS OF TWIST DRILL AND STEEL WIRE GAUGE.

No.	Size of Number in Decimals	No.	Size of Number in Decimals.	No.	Size of Number in Decimals.	No.	Size of Number in Decimals
1	.2280	21	.1590	41	.0960	61	0390
2	.2210	22	.1570	42	.0935	62	.0380
3	.2130	23	.1540	43	.0890	63	.0370
4	.2090	24	.1520	44	.0860	64	.0360
5	.2055	25	.1495	45	.0820	65	.0350
6	.2040	26	.1470	46	.0810	66	.0330
7	.2010	27	.1440	47	.0785	67	.0320
8	.1990	28	.1405	48	.0760	68	.0310
9	.1960	29	.1360	49	.0730	69	.02925
10	.1935	30	.1285	50	.0700	70	.0280
11	.1910	31	.1200	51	.0670	71	.0260
12	.1890	32	.1160	52	.0635	72	.0250
13	.1850	33	.1130	53	.0595	73	.0240
14	.1820	34	.1110	54	.0550	74	.0225
15	.1800	35	.1100	55	.0520	75	.0210
16	.1770	36	.1065	56	.0465	76	.0200
17	.1730	37	.1040	57	.0430	77	.0180
18	.1695	38	.1015	58	.0420	78	.0160
19	.1660	39	.0995	59	.0410	79	.0145
20	.1610	40	.0980	60	.0400	80	.0135

NEW FORM OF ELECTRICAL RAILWAY.

A new form of electrical railway is being erected at St. Paul, Minn. The cars do not touch the ground, but are suspended from girders which form the track and at the same time the mains conveying the current. Speeds of from eight to ten miles per hour are expected.

TABLE FOR MAKING THE UNIVERSAL TAPS, WITH THE MOST SUITABLE PROPORTIONS REQUISITE FOR GOOD WORKING TAPS USED BY HAND.

From 1/4 to 9/16 the head is turned the same size as the screw; the 5/8, and all above, to pass through the holes screwed. As the same table shows the size of tap and bottom of screw, the workmen will be enabled to make the tapping holes a size that will insure a full thread. The bottom of screw will give the size for drills, bits, etc.

Diameter of tap.	Bottom of thread, or tapping hole.	Full length of tap.	Length of screw part.	Head length of square.	Number of threads per inch.	Wheels for cutting the screws.			
						Mandrel.	Intermediate.	Pinion.	Screw.
1/4	3/16	2 1/4	1 1/8	7/16	20	40	80	20	100
5/16	1/4	2 1/2	1 5/16	7/16	18	40	80	20	90
3/8	1/4 and 3/64	2 3/4	1 1/2	9/16	16	45	80	20	90
						Simple wheels.			
7/16	11/32	3 1/8	1 3/4	5/8	14	20	....	....	140
1/2	13/32	3 1/2	2	11/16	12	20	....	....	120
9/16	15/32	3 3/4	2 1/8	11/16	12	20	....	....	120
5/8	1/2 and 1/64	4	2 1/4	3/4	11	20	....	....	110
11/16	9/16 and 1/64	4 1/4	2 3/8	3/4	11	20	....	....	110
3/4	5/8	4 1/2	2 5/8	3/4 and 1/16	10	20	....	....	100
7/8	11/16 and 3/64	5	2 7/8	7/8	9	20	....	....	90
1	3/4 and 3/32	5 1/2	3 1/4	7/8	8	20	....	....	80
1 1/8	15/16	6	3 1/2	1	7	20	....	....	70
1 1/4	1 and 3/64	6 1/2	3 3/4	1 1/8	7	20	....	....	70
1 3/8	1 5/32	7	4 1/4	1 1/8	6	20	....	....	60

TABLE FOR MAKING THE UNIVERSAL TAPS—Continued.

Diameter of tap.	Bottom of thread, or tapping hole.	Full length of tap.	Length of screw part.	Head length of square.	Number of threads per inch.	Wheels for cutting the screws.	
						Mandrel.	Screw
$1\frac{1}{2}$	$1\frac{9}{32}$	$7\frac{3}{4}$	$4\frac{3}{4}$	$1\frac{3}{8}$	6	20	60
$1\frac{5}{8}$	$1\frac{11}{32}$	9	$5\frac{1}{4}$	$1\frac{3}{8}$	5	20	50
$1\frac{3}{4}$	$1\frac{7}{16}$ and $\frac{3}{64}$	$9\frac{1}{2}$	$5\frac{3}{4}$	$1\frac{3}{8}$	5	40	50
$1\frac{7}{8}$	$1\frac{19}{32}$	10	$6\frac{1}{4}$	$1\frac{1}{2}$	$4\frac{1}{2}$	40	90
2	$1\frac{5}{8}$ and $\frac{3}{32}$	11	$6\frac{3}{4}$	$1\frac{1}{2}$	$4\frac{1}{2}$	40	90
$2\frac{1}{8}$	$1\frac{3}{4}$ and $\frac{3}{32}$	$11\frac{1}{2}$	$7\frac{1}{4}$	$1\frac{1}{2}$	$4\frac{1}{2}$	40	90
$2\frac{1}{4}$	$1\frac{7}{8}$ and $\frac{1}{16}$	12	$7\frac{3}{4}$	$1\frac{5}{8}$	4	40	80
$2\frac{3}{8}$	$2\frac{3}{64}$	$12\frac{1}{2}$	$8\frac{1}{4}$	$1\frac{5}{8}$	4	40	80
$2\frac{1}{2}$	$2\frac{3}{16}$	13	$10\frac{3}{4}$	$1\frac{5}{8}$	4	40	80
$2\frac{5}{8}$	$2\frac{5}{16}$	13	$9\frac{1}{4}$	$1\frac{3}{4}$	4	40	80
$2\frac{3}{4}$	$2\frac{3}{8}$	$13\frac{1}{2}$	$9\frac{3}{4}$	$1\frac{3}{4}$	$3\frac{1}{2}$	40	70
$2\frac{7}{8}$	$2\frac{1}{2}$	$13\frac{1}{2}$	10	$1\frac{3}{4}$	$3\frac{1}{2}$	40	70
3	$2\frac{5}{8}$	14	10	2	$3\frac{1}{2}$	40	70

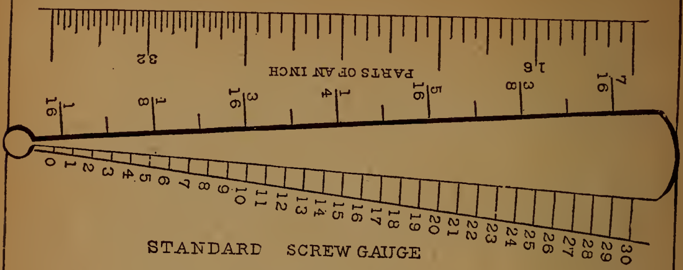
UNIVERSAL GAS-PIPE THREADS.

Diameter.	Wheels for Cutting, Etc.				Pitch.
	Mandrel.	Intermediate.	Pinion.	Screw.	
$1\frac{1}{4}$ and all above....	85	80	20	120	11.294
1	20	....	....	140	14.
$\frac{3}{4}$	20	....	....	140	14.
$\frac{5}{8}$	30	65	20	85	18.412
Small brass tube....	30	60	20	120	24.

Different Standards for Wire Gauge in use in the United States.

Dimensions of Sizes in Decimal Parts of an Inch.

Number of Wire Gauge.	American or Brown & Sharpe.	Birmingham, or Stubs' Wire.	Washburn & Moen Mfg. Co., Worcester, Ms.	Imperial Wire Gauge.	Stubs' Steel Wire.	U. S. Stand. for Plate.	Number of Wire Gauge.
000000	....	....	....	.464	....	.46875	000000
00000	....	....	....	.432	....	.4375	00000
0000	.46	.454	.3938	.400	....	.40625	0000
000	.40964	.425	.3625	.372	....	.375	000
00	.3648	.38	.3310	.348	....	.34375	00
0	.32486	.34	.3065	.324	....	.3125	0
1	.2893	.3	.2830	.300	.227	.28125	1
2	.25763	.284	.2625	.276	.219	.265625	2
3	.22942	.259	.2437	.252	.212	.25	3
4	.20431	.238	.2253	.232	.207	.234375	4
5	.18194	.22	.2070	.212	.204	.21875	5
6	.16202	.203	.1920	.192	.201	.203125	6
7	.14428	.18	.1770	.176	.199	.1875	7
8	.12849	.165	.1620	.160	.197	.171875	8
9	.11443	.148	.1483	.144	.194	.15625	9
10	.10189	.134	.1350	.128	.191	.140625	10
11	.090742	.12	.1205	.116	.188	.125	11
12	.080808	.109	.1055	.104	.185	.109375	12
13	.071961	.095	.0915	.092	.182	.09375	13
14	.064084	.083	.0800	.080	.180	.078125	14
15	.057068	.072	.0720	.072	.178	.0703125	15
16	.05082	.065	.0625	.064	.175	.0625	16
17	.045257	.058	.0540	.056	.172	.05625	17
18	.040303	.049	.0475	.048	.168	.05	18
19	.03589	.042	.0410	.040	.164	.04375	19
20	.031961	.035	.0348	.036	.161	.0375	20
21	.028462	.032	.03175	.032	.157	.034375	21
22	.025347	.028	.0286	.028	.155	.03125	22
23	.022571	.025	.0258	.024	.153	.028125	23
24	.0201	.022	.0230	.022	.151	.025	24
25	.0179	.02	.0204	.020	.148	.021875	25
26	.01594	.018	.0181	.018	.146	.01875	26
27	.014195	.016	.0173	.0164	.143	.0171875	27
28	.012641	.014	.0162	.0149	.139	.015625	28
29	.011257	.013	.0150	.0136	.134	.0140625	29
30	.010025	.012	.0140	.0124	.127	.0125	30
31	.008928	.01	.0132	.0116	.120	.0109375	31
32	.00795	.009	.0128	.0108	.115	.01015625	32
33	.00708	.008	.0118	.0100	.112	.009375	33
34	.006304	.007	.0104	.0092	.110	.00859375	34
35	005614	.005	.0095	.0084	.108	.0078125	35
36	.005	.004	.0090	.0076	.106	.00703125	36
37	.004453	....	....	.0068	.103	.006640625	37
38	.003965	....	....	.0060	.101	.00625	38
39	.003531	....	....	.0052	.099	....	39
40	.003144	....	....	.0048	.097	....	40



STANDARD SCREW GAUGE

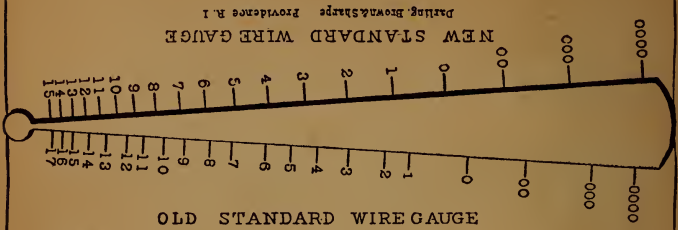
Screw Gauges Compared.

No. Screw Gauge.				Dimensions.		No. Screw Gauge.				Dimensions.	
American.	English.	German.	French.	Inches.	Millimetres.	American.	English.	German.	French.	Inches.	Millimetres.
	000	..	..	.0240	.61		6	..	..	.1360	3.45
000	..	..	..	.0315	.80	6	..	..	..	.1368	3.47
	00	..	..	.0380	.97				19	.1377	3.50
00	..	..	..	.0447	1.14			7		.1417	3.60
	0	..	..	.0520	1.32	7	7	..	..	.1500	3.81
		000	..	.0530	1.35			8	..	.1535	3.90
			10	.0570	1.45				20	.1574	4.00
0	..	..	..	.0578	1.47	8	..	..	..	.1631	4.14
		00	..	.0589	1.50		8	..	..	.1640	4.16
			11	.0629	1.60			9	..	.1653	4.20
		0	..	.0649	1.65	9	..	.	..	.1763	4.48
	.	..	..	.0660	1.68		9	..	..	.1780	4.52
			12	.0688	1 75			10	21	.1811	4.60
1	.	..	..	.0710	1.80	10	..	..	..	.1894	4.81
		1	..	.0728	1.85		10	..	..	.1920	4.88
			13	.0748	1.90			11	..	.1968	5.00
	2	..	..	.0800	2.30	11	..	..	..	.2026	5.15
			14	.0807	2.05				22	.2047	5.20
		2	..	.0826	2.10		11	..	..	.2068	5.23
2	..	..	..	.0842	2.14			12	..	.2125	5.40
			15	.0866	2.20	12	..	..	..	.2158	5.48
	3	..	..	.0940	2.39		12	..	..	.2200	5.59
		3	16	.0944	2.40			13	..	.2285	5.80
3	..	..	..	.0973	2.47	13		..	..	.2289	5.81
		4	17	.1062	2.70				23	.2322	5.90
	4	..	..	.1080	2.74		13	..	..	.2340	5.94
4	..	..	..	.1105	2.81	14		.	..	.2421	6.15
		5	18	.1181	3.00			14	..	.2440	6.20
	5	..	.	1220	3.09		14	..	..	.2480	6.29
5	..	..	.	.1236	3.14	15		..	..	.2552	6.48
		6		1269	3.30			15	24	.2598	6.60

Screw Gauges Compared.

CONTINUED.

No. Screw Gauge.				Dimensions.		No. Screw Gauge.				Dimensions.	
American.	English.	German.	French.	Inches.	Millimetres.	American	English.	German.	French.	Inches.	Millimetres.
	15	..	..	2620	6.65	28	..	..	..	.4263	10.83
16	..	..	..	.2684	6.82		27	..	..	.4300	10.92
		16	..	.2755	7.00			25	31	.4330	11.00
	16	..	..	.2760	7.01	29	..	..	..	.4395	11.16
17	..	..	..	.2816	7.15		28	..	..	.4440	11.28
			25	.2874	7.30	30	..	26	32	.4526	11.50
	17	..	..	.2900	7.37		29	..	..	.4580	11.63
		17	..	.2913	7.40	31	..	..	..	.4658	11.83
18	..	..	..	.2947	7.49		30	..	..	.4720	11.99
	18	..	..	.3040	7.72			27	..	.4724	12.00
		18	..	.3070	7.80	32	..	..	..	.4790	12.17
19	..	..	..	.3079	7.82		31	..	..	.4860	12.34
			26	.3149	8.00	33	..	..	33	.4921	12.50
	19	..	..	.3180	8.08		32	..	..	5000	12.70
20	..	..	..	.3210	8.15	34	..	..	..	.5053	12.83
		19	..	.3228	8.20		33	..	..	.5140	13.06
	20	..	..	.3320	8.43	35	..	..	..	.5184	13.17
21	..	..	..	.3342	8.49		34	..	..	.5280	13.41
		20	..	.3385	8.60	36	..	..	34	.5316	13.50
			27	.3425	8.70		35	..	..	.5420	13.51
	21	..	..	.3460	8.79	37	..	..	..	.5448	13.84
22	..	..	..	.3474	8.82		36	..	..	.5560	13.87
		21	..	.3543	9.00	38	..	..	..	.5579	14.17
	22	..	..	.3600	9.14		37	..	..	.5700	14.22
23	..	..	..	.3605	9.16				35	.5708	14.50
			28	.3700	9.40	39	..	..	..	.5711	14.51
24	..	..	..	.3737	9.49		38	..	..	.5840	14.58
	23	22	..	.3740	9.50	40	..	..	..	.5842	14.84
25	..	..	..	.3868	9.83		39	..	..	.5980	14.94
	24	..	..	.3880	9.85		40	..	..	.6120	15.29
		23	29	.3937	10.00				36	.6102	15.50
26	..	..	..	.4000	10.16				37	.6496	16.50
	25	..	..	.4020	10.21				38	.6889	17.50
27	..	..	..	.4132	10.49				39	.7322	18.50
		24	30	.4133	10.50				40	.7677	19.50
	26	..	..	.4160	10.57						



Wire and Screw Gauge Compared.

No. Wire Gauge.				Dimensions.		No. Wire Gauge.				Dimensions.	
B. W. G.	Paris.	W. & M.	S. G.	Inches.	Millimetres.	B. W. G	Paris	W. & M	S. G.	Inches.	Millimetres.
	40	..	..	.630	16.00	00	..	..	..	.380	9.65
	39	..	..	.606	15.40				24	.3737	9.49
			40	.5842	14.84		29	..	..	.370	9.40
	38	..	..	.582	14.78			000	..	.362	9.19
			39	.5711	14.51				23	.3605	9.16
	37	..	..	.559	14.20				22	.3474	8.82
			38	.5579	14.17		28		..	.346	8.80
			37	.5448	13.84	0	..		..	.340	8.64
	36	..	..	.535	13.59				21	.3342	8.49
	..		36	.5316	13.50			00	..	.331	8.41
			35	.5184	13.17		27	..	..	.323	8.20
	35	..	..	.512	13.01		..		20	.3210	8.15
			34	.5053	12.83				19	.3079	7.82
			33	.4921	12.50			0	..	.307	7.80
	34	..	..	.488	12.40	1	..	..	..	.300	7.62
			32	.4790	12.17		26	..	..	299	7.60
			31	.4658	11.83				18	2947	7.49
	33	..	..	.464	11.79	2	..	..	..	284	7.22
		000000	..	.460	11.68			1	..	283	7.19
0000	..	..	..	.454	11.53				17	.2816	7.15
			30	.4526	11.50		25	..	..	.276	7.00
	32	..	..	.441	11.20				16	.2684	6.82
			29	.4395	11.16			2	..	.263	6.68
		00000	..	.430	10.92	3	..	..	..	.259	6.58
			28	.4263	10.83				15	.2552	6.48
000	..	..	..	.425	10.79		24	..	..	.252	6.40
	31	..	..	.417	10.59		..	3	..	.244	6.20
			27	.4132	10.49				14	.2421	6.15
			26	.4000	10.16	4	..	..	..	.238	6.05
	30	0000	..	.393	10.00		23	..	..	.232	5.90
			25	.3868	9.83				13	.2289	5.81

Wire and Screw Gauge Compared.

CONTINUED.

No. Wire Gauge.				Dimensions.		No. Wire Gauge.				Dimensions.	
B. W. G.	Paris.	W. & M.	S. G.	Inches.	Millimetres.	B. W. G.	Paris.	W. & M.	S. G.	Inches.	Millimetres.
		4	..	.225	5.72		11	16	..	.063	1.60
5	..	..	..	.220	5.59		10	..	..	.059	1.50
			12	.2158	5.48	17	..	..	..	.058	1.47
	22	..	..	.213	5.40				0	.0578	1.47
		5	..	.207	5.26		9	..	..	.055	1.40
6	..	..	..	.203	5.16			17	..	.054	1.37
			11	.2026	5.15		8	..	..	.051	1.30
	21	..	..	.193	4.90	18	..	..	..	.049	1.24
		6	..	.192	4.88		7	18	..	.047	1.20
			10	.1894	4.81				00	.0447	1.14
7	..	..	..	.180	4.57		6	..	..	.043	1.10
		7	..	.177	4.50	19	..	..	..	.042	1.07
			9	.1763	4.48			19	..	.041	1.04
	20	..	..	.173	4.40		5	..	..	.039	1.00
8	..	..	..	.165	4.19	20	4	20	..	.035	.88
			8	.1631	4.14	21	..	21	..	.032	.81
		8	..	.162	4.11				000	.0315	.80
	19	..	..	.154	3.90		3	..	..	.031	.80
			7	.1500	3.81	22	..	22	..	.028	.71
9	..	9	..	.148	3.76		2	..	..	.027	.70
			6	.1368	3.47	23	..	23	..	.025	.63
		10	..	.135	3.43		1	24	..	.023	.60
10	18	..	..	.134	3.40	24	..	..	.	.022	.56
			5	.1236	3.14	25	P	25	..	.020	.51
11	..	11	..	.120	3.05	26	..	26	..	.018	.46
	17	..	..	.118	3.00			27	..	.017	.43
			4	.1105	2.81	27	..	28	..	.016	.41
12	..	..	..	.109	2.77			29	..	.015	.38
	16	..	..	.106	2.70	28	..	30	..	.014	.36
		12	..	.105	2.77			31	..	.0135	.34
			3	.0973	2.47	29	..	32	..	.013	.33
13		..	..	.095	2.41	30	..	..	..	.012	.30
	15	..	..	.094	2.40			33	..	.011	.28
		13	..	.092	2.34	31	..	34	..	.010	.25
	14	..	..	.087	2.20			35	..	.0095	.24
			2	.0842	2.14	32	..	36	..	.009	.23
14	..	..	..	.083	2.11			37	..	.0085	.22
		14	..	.080	2.03	33	..	38	.	.008	.20
	13	..	..	.078	2.00			39	..	.0075	.19
15	..	15	..	.072	1.83	34	..	40	..	.007	.18
			1	.071	1.80	35	..	..	..	.005	.13
	12	..	..	.070	1.80	36	..	..	..	.004	.10
16	...	..	..	.065	1.65						

SIZES OF NUMBERS OF THE U. S. STANDARD GAUGE.

FOR SHEET AND PLATE IRON AND STEEL

An Act Establishing a Standard Gauge for Sheet and Plate Iron and Steel.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That for the purpose of securing uniformity the following is established as the only gauge for sheet and plate iron and steel in the United States of America, namely:

Number of Gauge.	Approximate Thickness in Fractions of an Inch.	Approximate Thickness in Decimal Parts of an Inch.	Weight per Square Foot in Ounces Avoirdupois.	Weight per Square Foot in Pounds Avoirdupois.
0000000	1-2	.5	320	20.00
000000	15-32	.46875	300	18.75
00000	7-16	.4375	280	17.50
0000	13-32	.40625	260	16.25
000	3-8	.375	240	15.
00	11-32	.34375	220	13.75
0	5-16	.3125	200	12.50
1	9-32	.28125	180	11.25
2	17-64	.265625	170	10.625
3	1-4	.25	160	10.
4	15-64	.234375	150	9.375
5	7-32	.21875	140	8.75
6	13-64	.203125	130	8.125
7	3-16	.1875	120	7.5
8	11-64	.171875	110	6.875
9	5-32	.15625	100	6.25
10	9-64	.140625	90	5.625
11	1-8	.125	80	5.
12	7-64	.109375	70	4.375
13	3-32	.09375	60	3.75
14	5-64	.078125	50	3.125
15	9-128	.0703125	45	2.8125
16	1-16	.0625	40	2.5
17	9-160	.05625	36	2.25
18	1-20	.05	32	2.
19	7-160	.04375	28	1.75
20	3-80	.0375	24	1.50
21	11-320	.034375	22	1.375
22	1-32	.03125	20	1.25
23	9-320	.028125	18	1.125
24	1-40	.025	16	1.
25	7-320	.021875	14	.875
26	3-160	.01875	12	.75
27	11-640	.0171875	11	.6875
28	1-64	015625	10	.625
29	9-640	.0140625	9	.5625
30	1-80	.0125	8	.5
31	7-640	.0109375	7	.4375
32	13-1280	.01015625	6 1-2	.40625
33	3-320	.009375	6	.375
34	11-1280	.00859375	5 1-2	.34375
35	5-640	.0078125	5	.3125
36	9-1280	.00703125	4 1-2	.28125
37	17-2560	.006640625	4 1-4	.265625
38	1-160	.00625	4	.25

WEIGHT OF IRON AND STEEL SHEETS.

Weights Per Square Foot.—*Kent.*

Thickness by Birmingham Gauge.				Thickness by American (Brown and Sharpe's) Gauge.			
No. of Gauge.	Thickness in Inches.	Iron.	Steel.	No. of Gauge.	Thickness in Inches.	Iron.	Steel.
0000	.454	18.16	18.52	0000	.46	18.40	18.77
000	.425	17.00	17.34	000	.4096	16.38	16.71
00	.38	15.20	15.30	00	.3648	14.59	14.88
0	.34	13.60	13.87	0	.3249	13.00	13.26
1	.3	12.00	12.24	1	.2893	11.57	11.80
2	.284	11.36	11.59	2	.2576	10.30	10 51
3	.259	10.36	10.57	3	.2294	9.18	9.36
4	.238	9.52	9.71	4	.2043	8.17	8.34
5	.22	8.80	8.98	5	.1819	7.28	7.42
6	.203	8.12	8.28	6	.1620	6.48	6.61
7	.18	7.20	7.34	7	.1443	5.77	5.89
8	.165	6.60	6.73	8	.1285	5.14	5.24
9	.148	5.92	6.04	9	.1144	4.58	4.67
10	.134	5.36	5.47	10	.1019	4.08	4.16
11	.12	4.80	4.90	11	.0907	3.63	3.70
12	.109	4.36	4.45	12	.0808	3.23	3.30
13	.095	3.80	3.88	13	.0720	2.88	2.94
14	.083	3.32	3.39	14	.0641	2.56	2 62
15	.072	2.88	2.94	15	.0571	2.28	2.33
16	.065	2.60	2.65	16	.0508	2.03	2.07
17	.058	2.32	2.37	17	.0453	1.81	1.85
18	.049	1.96	2.00	18	.0403	1.61	1 64
19	.042	1.68	1.71	19	.0359	1 44	1.46
20	.035	1.40	1.43	20	.0320	1 28	1.31
21	.032	1.28	1.31	21	.0285	1.14	1.16
22	.028	1.12	1.14	22	.0253	1.01	1.03
23	.025	1 00	1.02	23	.0226	.904	.922
24	.022	.88	.898	24	.0201	.804	.820
25	.02	.80	.816	25	.0179	.716	.730
26	.018	.72	.734	26	.0159	.636	.649
27	.016	.64	.653	27	.0142	.568	.579
28	.014	.56	.571	28	.0126	.504	.514
29	.013	.52	.530	29	.0113	.452	.461
30	.012	.48	.490	30	.0100	.400	.408
31	.01	.40	.408	31	.0089	.356	.363
32	.009	.36	.367	32	.0080	.320	.326
33	.008	.32	.326	33	.0071	.284	.290
34	.007	.28	.286	34	.0063	.252	.257
35	.005	.20	.204	35	.0056	.224	.228

	Iron.	Steel.
Specific gravity	7.7	7.854
Weight per cubic foot	480.	489.6
Weight per cubic inch	.2778	.2833

As there are many gauges in use differing from each other, and even the thickness of a certain specified gauge, as the Birmingham, are not assumed the same by all manufacturers, orders for sheets and wiers should always state the weight per square foot, or the thickness in thousandths of an inch.

SQUARE AND ROUND BAR IRON.

Thickness or Diameter in Inches.	Weight of Square Bar one ft. long.	Weight of Round Bar one ft. long.
0		
$\frac{1}{16}$	.013	.010
$\frac{1}{8}$	.052	.041
$\frac{3}{16}$	.117	.092
$\frac{1}{4}$	.208	.164
$\frac{5}{16}$	.326	.256
$\frac{3}{8}$	.469	.368
$\frac{7}{16}$	.638	.501
$\frac{1}{2}$	.833	.654
$\frac{9}{16}$	1.055	.828
$\frac{5}{8}$	1.302	1.023
$\frac{11}{16}$	1.576	1.237
$\frac{3}{4}$	1.875	1.473
$\frac{13}{16}$	2.201	1.728
$\frac{7}{8}$	2.552	2.004
$\frac{15}{16}$	2.930	2.301
1	3.333	2.618
$\frac{1}{16}$	3.763	2.955
$\frac{1}{8}$	4.219	3.313
$\frac{3}{16}$	4.701	3.692
$\frac{1}{4}$	5.208	4.091
$\frac{5}{16}$	5.742	4.510
$\frac{3}{8}$	6.302	4.950
$\frac{7}{16}$	6.888	5.410
$\frac{1}{2}$	7.500	5.890
$\frac{9}{16}$	8.138	6.392
$\frac{5}{8}$	8.802	6.913
$\frac{11}{16}$	9.492	7.455
$\frac{3}{4}$	10.21	8.018
$\frac{13}{16}$	10.95	8.601
$\frac{7}{8}$	11.72	9.204
$\frac{15}{16}$	12.51	9.828

Thickness or Diameter in Inches.	Weight of Square Bar one ft. long.	Weight of Round Bar one ft. long.
2	13.33	10.47
$\frac{1}{16}$	14.18	11.14
$\frac{1}{8}$	15.05	11.82
$\frac{3}{16}$	15.95	12.53
$\frac{1}{4}$	16.88	13.25
$\frac{5}{16}$	17.83	14.00
$\frac{3}{8}$	18.80	14.77
$\frac{7}{16}$	19.80	15.55
$\frac{1}{2}$	20.83	16.36
$\frac{9}{16}$	21.89	17.19
$\frac{5}{8}$	22.97	18.04
$\frac{11}{16}$	24.08	18.91
$\frac{3}{4}$	25.21	19.80
$\frac{13}{16}$	26.37	20.71
$\frac{7}{8}$	27.55	21.64
$\frac{15}{16}$	28.76	22.59
3	30.00	23.56
$\frac{1}{16}$	31.26	24.55
$\frac{1}{8}$	32.55	25.57
$\frac{3}{16}$	33.87	26.60
$\frac{1}{4}$	35.21	27.65
$\frac{5}{16}$	36.58	28.73
$\frac{3}{8}$	37.97	29.82
$\frac{7}{16}$	39.39	30.94
$\frac{1}{2}$	40.83	32.07
$\frac{9}{16}$	42.30	33.23
$\frac{5}{8}$	43.80	34.40
$\frac{11}{16}$	45.33	35.60
$\frac{3}{4}$	46.88	36.82
$\frac{13}{16}$	48.45	38.05
$\frac{7}{8}$	50.05	39.31
$\frac{15}{16}$	51.68	40.59

Thickness or Diameter in Inches.	Weight of Square Bar one ft. long.	Weight of Round Bar one ft. long.
4	53.33	41.89
$\frac{1}{16}$	55.01	43.21
$\frac{1}{8}$	56.72	44.55
$\frac{3}{16}$	58.45	45.91
$\frac{1}{4}$	60.21	47.29
$\frac{5}{16}$	61.99	48.69
$\frac{3}{8}$	63.80	50.11
$\frac{7}{16}$	65.64	51.55
$\frac{1}{2}$	67.50	53.01
$\frac{9}{16}$	69.39	54.50
$\frac{5}{8}$	71.30	56.00
$\frac{11}{16}$	73.24	57.52
$\frac{3}{4}$	75.21	59.07
$\frac{13}{16}$	77.20	60.63
$\frac{7}{8}$	79.22	62.22
$\frac{15}{16}$	81.26	63.82
5	83.33	65.45
$\frac{1}{16}$	85.43	67.10
$\frac{1}{8}$	87.55	68.76
$\frac{3}{16}$	89.70	70.45
$\frac{1}{4}$	91.88	72.16
$\frac{5}{16}$	94.08	73.89
$\frac{3}{8}$	96.30	75.64
$\frac{7}{16}$	98.55	77.40
$\frac{1}{2}$	100.8	79.19
$\frac{9}{16}$	103.1	81.00
$\frac{5}{8}$	105.5	82.83
$\frac{11}{16}$	107.8	84.69
$\frac{3}{4}$	110.2	86.56
$\frac{13}{16}$	112.6	88.45
$\frac{7}{8}$	115.1	90.36
$\frac{15}{16}$	117.5	92.29
6	120.0	94.25

ESTIMATED WEIGHT OF FLAT ROLLED IRON.

ONE FOOT IN LENGTH.

Width. Inches.	Thickness. $\frac{1}{8}$ in.	$\frac{3}{16}$ in.	$\frac{1}{4}$ in.	$\frac{5}{16}$ in.	$\frac{3}{8}$ in.	$\frac{7}{16}$ in.	$\frac{1}{2}$ in.	$\frac{5}{8}$ in.	$\frac{3}{4}$ in.	$\frac{7}{8}$ in.	1 in.	$1\frac{1}{4}$ in.
$\frac{1}{2}$	.242	.316	.422	.528	.634	.738	.845	1.056	1.265	1.477	1.690	2.112
$\frac{5}{8}$	.276	.395	.528	.660	.792	.923	1.056	1.320	1.584	1.846	2.112	2.640
$\frac{3}{4}$	.316	.474	.633	.792	.950	1.108	1.265	1.584	1.901	2.217	2.534	3.168
$\frac{7}{8}$	.369	.553	.738	.923	1.108	1.294	1.477	1.846	2.217	2.588	2.956	3.696
1	.422	.632	.845	1.056	1.267	1.478	1.690	2.112	2.534	2.956	3.380	4.224
$1\frac{1}{8}$	.474	.711	.950	1.187	1.425	1.663	1.901	2.375	2.850	3.326	3.802	4.752
$1\frac{1}{4}$	.528	.790	1.056	1.320	1.584	1.848	2.112	2.640	3.168	3.696	4.224	5.280
$1\frac{3}{8}$	.581	.869	1.161	1.452	1.742	2.032	2.325	2.904	3.484	4.065	4.646	5.808
$1\frac{1}{2}$	.634	.948	1.266	1.584	1.900	2.217	2.535	3.168	3.802	4.435	5.069	6.337
$1\frac{5}{8}$	.687	1.027	1.372	1.716	2.059	2.402	2.746	3.432	4.119	4.805	5.492	6.864
$1\frac{3}{4}$	.740	1.106	1.479	1.848	2.218	2.589	2.957	3.696	4.435	5.178	5.914	7.393
$1\frac{7}{8}$	.793	1.185	1.584	1.980	2.376	2.772	3.168	3.960	4.752	5.544	6.336	7.921
2	.846	1.264	1.689	2.112	2.534	2.957	3.379	4.224	5.069	5.914	6.758	8.448
$2\frac{1}{8}$	.899	1.343	1.795	2.244	2.693	3.141	3.591	4.488	5.386	6.283	7.181	8.977
$2\frac{1}{4}$	.952	1.422	1.900	2.376	2.851	3.326	3.802	4.751	5.703	6.653	7.604	9.505
$2\frac{3}{8}$	1.005	1.501	2.006	2.508	3.009	3.511	4.013	5.016	6.019	7.022	8.025	10.032
$2\frac{1}{2}$	1.058	1.580	2.112	2.640	3.168	3.696	2.224	5.280	6.336	7.392	8.448	10.560
$2\frac{3}{4}$	1.264	1.659	2.323	2.904	3.485	4.066	4.647	5.808	6.970	8.132	9.294	11.617
3	1.370	1.817	2.535	3.168	3.802	4.435	5.069	6.337	7.604	8.871	10.138	12.673
$3\frac{1}{4}$	1.476	1.975	2.746	3.432	4.119	4.805	5.492	6.865	8.237	9.610	10.983	13.730
$3\frac{1}{2}$	1.582	2.132	2.957	3.696	4.436	5.175	5.914	7.393	8.871	10.350	11.828	14.785
$3\frac{3}{4}$	1.688	2.291	3.168	3.960	4.752	5.544	6.336	7.921	9.505	11.089	12.673	15.841
4	1.794	2.449	3.380	4.224	5.069	5.914	6.759	8.448	10.138	11.828	13.518	16.897
$4\frac{1}{2}$	1.906	2.607	3.802	4.752	5.703	6.653	7.604	9.504	11.406	13.306	15.208	19.010
5	2.118	2.923	4.224	5.280	6.336	7.392	8.449	10.560	12.673	14.784	16.897	21.122
$5\frac{1}{2}$	2.330	3.239	4.647	5.808	6.970	8.132	9.294	11.616	13.940	16.264	18.587	23.234
6	2.542	3.555	5.070	6.337	7.604	8.871	10.138	12.674	15.208	17.742	20.276	25.346

ESTIMATED WEIGHT OF HALF ROUND, OVAL, AND HALF OVAL IRON.

PER LINEAL FOOT.

SIZE HALF ROUND.	SIZE OVAL.	WEIGHT PER FOOT.	SIZE HALF OVAL.	WEIGHT PER FOOT.
$\frac{3}{8}$	$\frac{3}{8} \times \frac{3}{16}$	.186	$\frac{3}{8} \times \frac{3}{32}$	.093
$\frac{7}{16}$	$\frac{7}{16} \times \frac{7}{32}$	.253	$\frac{7}{16} \times \frac{7}{64}$	.127
$\frac{1}{2}$	$\frac{1}{2} \times \frac{1}{4}$	.331	$\frac{1}{2} \times \frac{1}{8}$	.166
$\frac{5}{8}$	$\frac{5}{8} \times \frac{5}{16}$	.517	$\frac{5}{8} \times \frac{5}{32}$	.259
$\frac{3}{4}$	$\frac{3}{4} \times \frac{3}{8}$	.744	$\frac{3}{4} \times \frac{3}{16}$	.372
$\frac{7}{8}$	$\frac{7}{8} \times \frac{7}{16}$	1.013	$\frac{7}{8} \times \frac{7}{32}$	.507
1	$1 \times \frac{1}{2}$	1.323	$1 \times \frac{1}{4}$	.662
$1\frac{1}{8}$	$1\frac{1}{8} \times \frac{9}{16}$	1.624	$1\frac{1}{8} \times \frac{9}{32}$	.812
$1\frac{1}{4}$	$1\frac{1}{4} \times \frac{5}{8}$	2.067	$1\frac{1}{4} \times \frac{5}{16}$	1.034
$1\frac{1}{2}$	$1\frac{1}{2} \times \frac{3}{4}$	2.976	$1\frac{1}{2} \times \frac{3}{8}$	1.488

ESTIMATED WEIGHT OF HOOP IRON.

PER LINEAL FOOT ROLLED TO PARTRIDGE GAUGE.

WIDTH IN INCHES.	NUMBER OF WIRE GAUGE.									
	13	14	15	16	17	18	19	20	21	22
$\frac{5}{8}$	......	.1628	......	.1302	.1139	.0976	.0895	.0814	.0731	.0651
$\frac{3}{4}$	......	.1953	......	.1562	.1367	.1171	.1074	.0976	.0877	.0781
$\frac{7}{8}$	......	.2278	......	.1822	.1595	.1367	.1253	.1139	.1023	.0912
1	......	.2604	......	.2083	.1822	.1562	.1432	.1302	.1169	.1041
$1\frac{1}{8}$	.352	.293	.264	.234	.205	.176	.161	.146	......	......
$1\frac{1}{4}$	.391	.326	.293	.26	.229	.195	.179	.163	......	......
$1\frac{3}{8}$	.43	.358	.322	.286	.251	.215	.197	.179	......	......
$1\frac{1}{2}$	.469	.391	.352	.313	.273	.234	.215	.195	......	......
$1\frac{5}{8}$	.508	.423	.381	.339	.296	.254	......	......	......	......
$1\frac{3}{4}$	.547	.456	.41	.365	.319	.273	......	......	......	......
2	.625	.521	.469	.417	.365	.313	......	......	......	......
$2\frac{1}{4}$	.703	.586	.527	.469	......	......	......	......	......	......
$2\frac{1}{2}$	.781	.651	.586	.521	......	......	......	......	......	......

ESTIMATED WEIGHT OF TIRE IRON.

PER SET OF 54 FEET.

WIDTH IN INCHES.	THICKNESS.										
	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs
$\frac{3}{4}$	25	34	......	......	......	......	......	......	......	......	......
$\frac{7}{8}$	30	40	50	......	......	......	......	......	......	......	......
1	34	45	57	68	80	91	......	......	......	......	......
$1\frac{1}{8}$	38	51	64	77	90	103	116	......	......	......	......
$1\frac{1}{4}$	......	57	71	85	100	114	128	143	......	......	......
$1\frac{3}{8}$	......	63	78	94	109	126	141	157	......	......	......
$1\frac{1}{2}$	......	68	85	103	118	137	154	171	201	239	273
$1\frac{5}{8}$	......	......	......	111	130	148	166	185	222	259	296
$1\frac{3}{4}$	......	......	......	120	140	160	180	200	239	279	319
2	......	......	......	135	160	180	250	228	274	319	365
$2\frac{1}{4}$	......	......	......	......	......	205	......	256	304	359	416
$2\frac{1}{2}$	......	......	......	......	......	228	......	285	342	399	456

ESTIMATED WEIGHT OF WAGON BOX IRON.

Width in Inches.	Wire Gauge.	Weight per Foot.	Approx. No. of Feet in Bundle.	No. Feet in Ton, 2,000 Lbs.
3/4	No. 10	.295	380	6,770
3/4	" 11	.264	422	7,575
3/4	" 12	.233	480	8,580
7/8	" 10	.350	320	5,710
7/8	" 11	.309	362	6,470
1	" 10	.4	280	5,000

ESTIMATED WEIGHT OF STEEL TIRE.

PER SET OF 54 FEET.

SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.
5/8 by 1/16 in.....	7 1/2 lbs.	7/8 by 1/4 in....	40 1/2 lbs.	1 1/4 by 3/8 in....	88 1/2 lbs.
5/8 " 3/32 ".....	11 1/2 "	1 " 1/8 "....	23 3/4 "	1 3/8 " 3/8 "....	98 "
5/8 " 1/8 ".....	15 1/4 "	1 " 5/32 "....	29 1/2 "	1 1/2 " 3/8 "....	107 "
5/8 " 3/16 ".....	22 3/4 "	1 " 3/16 "....	35 1/2 "	1 1/2 " 7/16 "....	124 "
7/8 " 7/32 ".....	35 1/2 "	1 " 7/32 "....	42 1/4 "	1 1/2 " 1/2 "....	142 "
3/4 " 3/32 ".....	13 1/4 "	1 " 1/4 "....	47 1/2 "	1 5/8 " 1/2 "....	154 "
3/4 " 1/8 ".....	18 "	1 " 5/16 "....	58 1/2 "	1 5/8 " 5/8 "....	178 "
3/4 " 5/32 ".....	22 "	1 1/8 " 3/16 "....	40 1/2 "	1 3/4 " 1/2 "....	165 "
3/4 " 3/16 ".....	27 "	1 1/8 " 1/4 "....	54 "	1 3/4 " 5/8 "....	197 "
3/4 " 1/4 ".....	35 1/2 "	1 1/8 " 5/16 "....	67 1/2 "	1 3/4 " 3/4 "....	236 "
7/8 " 3/32 ".....	15 1/4 "	1 1/8 " 3/8 "....	81 "	2 " 1/2 "....	190 "
7/8 " 1/8 ".....	20 1/4 "	1 1/4 " 1/4 "....	59 "	2 " 5/8 "....	225 "
7/8 " 5/32 ".....	25 "	1 1/4 " 5/16 "....	74 "	2 " 3/4 "....	270 "

WEIGHT OF THIMBLE SKEINS.

SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.
2 by 6 in......	22 lbs.	2 3/4 by 9 in....	50 lbs.	3 3/4 by 11 in....	92 lbs.
2 " 6 1/2 "......	22 "	3 " 9 "....	56 "	3 1/2 " 12 "....	90 "
2 1/8 " 6 1/2 "......	24 "	3 1/4 " 9 "....	70 "	3 3/4 " 12 "....	96 "
2 1/4 " 7 "......	30 "	3 " 10 "....	60 "	4 " 12 "....	116 "
2 1/4 " 7 1/2 "......	30 "	3 1/4 " 10 "....	70 "	4 1/4 " 12 "....	146 "
2 1/2 " 7 1/2 "......	36 "	3 1/4 " 11 "....	72 "	4 1/2 " 12 "....	172 "
2 1/2 " 8 "......	36 "	3 1/2 " 10 "....	76 "	4 1/2 " 13 "....	176 "
2 3/4 " 8 "......	46 "	3 1/2 " 10 1/2 "....	80 "	5 " 14 "....	264 "
2 3/4 " 8 1/2 "......	48 "	3 1/2 " 11 "....	84 "	5 1/4 " 14 "....	300 "

WEIGHT OF COLUMBUS STEEL SKEINS.

SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.	SIZE.	WEIGHT, PER SET.
2 1/2 by 7 1/2 in..	47 lbs.	3 by 9 in.	66 lbs.	3 1/2 by 11 in..	94 lbs.	4 by 12 in..	110 lbs.
2 1/2 " 8 "..	50 "	3 " 10 "	66 "	3 1/2 " 12 "..	97 "	4 1/4 " 12 "..	134 "
2 3/4 " 8 "..	52 "	3 1/4 " 10 "	80 "	3 3/4 " 11 "..	100 "	4 1/2 " 13 "..	165 "
2 3/4 " 8 1/2 "..	53 "	3 1/2 " 10 1/2 "	88 "	3 3/4 " 12 "..	100 "	5 " 14 "..	185 "

APPROXIMATE WEIGHT AND STRENGTH OF CORDAGE.

Size in Circumference.	Size in Diameter.	Weight of 100 Fathoms Manila in Lbs.	Weight of 100 Fathoms Tarred Hemp in Lbs.	Strength of Manila Rope in Lbs.	Length of Manila Rope in One Lb.
Fine 6 thd	3/16 in.	12	17	540	50 feet,
6 "	¼ "	18	24	780	33 " 4 in.
9 "	5/16 "	24	34	1,000	25 "
12 "	⅜ "	30	45	1,280	20 "
1¼ "	7/16 "	37	50	1,562	17 " 8 in.
1½ "	½ "	46	55	2,250	13 "
1¾ "	9/16 "	65	75	3,062	9 " 3 "
2 "	⅝ "	80	100	4,000	7 " 6 "
2¼ "	¾ "	98	125	5,000	6 "
2½ "	13/16 "	120	155	6,250	5 "
2¾ "	⅞ "	142	190	7,500	4 " 3 "
3 "	1 "	170	225	9,000	3 " 6 "
3¼ "	1 1/16 "	200	265	10,500	3 "
3½ "	1⅛ "	230	300	12,250	2 " 7 "
3¾ "	1¼ "	271	350	14,000	2 " 3 "
4 "	1 5/16 "	310	405	16,000	1 " 11 "
4¼ "	1⅜ "	346	455	18,062	1 " 8 "
4½ "	1½ "	390	510	20,250	1 " 6 "
4¾ "	1 9/16 "	435	575	22,500	1 " 5 "
5 "	1⅝ "	480	640	25,000	1 " 3 "
5½ "	1¾ "	581	775	30,250	1 "
6 "	2 "	678	930	36,000	10⅔ "
6½ "	2⅛ "	797	1,075	42,250	9 "
7 "	2¼ "	920	1,245	49,000	7⅔ "
7½ "	2½ "	1,106	1,405	56,250	6½ "
8 "	2⅝ "	1,265	1,600	64,000	5½ "
8½ "	2⅞ "	1,420	1,780	72,250	5 "
9 "	3 "	1,572	2,030	81,000	4½ "
9½ "	3⅛ "	1,760	2,285	90,250	4 "
10 "	3⅜ "	1,951	2,550	100,000	3½ "

Manila is about 25 per cent. stronger than Sisal.

Hawser-laid Rope will weigh one-sixth more.

Tarred Hemp Rope weighs about one-fourth more than Manila Rope.

Manila, Sisal and Jute weigh about the same.

RAILS PER MILE.

To calculate the number of gross tons of rails for a mile of track, multiply the weight of the rail per yard by $1\frac{4}{7}$ and the product will be the exact weight in tons per mile.

Weight per yd.	Gross Tons per mile.	Weight per yd.	Gross Tons per mile.	Weight per yd.	Net Tons per mile.	Weight per yd.	Net Tons per mile.
60-lb	94.30	40-lb	62.86	20-lb	35.20	12-lb	21.12
56	88.00	35	55.00	18	31.68	10	17.60
50	78.57	30	47.14	16	28.16	8	14.08
45	70.71	25	39.29	14	24,64	6	10.56

CROSS-TIES PER MILE.

$1\frac{1}{2}$ feet, center to center	3,520 ties.	2 feet, center to center	2,640 ties.
$1\frac{3}{4}$ " " "	3,017 "	$2\frac{1}{4}$ " " "	2,348 "
$2\frac{1}{2}$ " " "			2,113 "

WEIGHT AND NUMBER OF FISH PLATES AND BOLTS REQUIRED PER MILE

Lengths of Rails.	No. of Joints per mile.	Lbs. of Plates per mile.	Lbs. of Bolts per mile.	Total Weight per mile.
18 feet	588	9,408	2,352	11,760
21 "	528	8,448	2,112	10,560
24 "	440	7,040	1,760	8,800
25 "	423	6,768	1,682	8,460
27 "	391	6,256	1,564	7,820
30 "	352	5,632	1,408	7,040

Note.—If double nuts are used, add $37\frac{1}{2}$ per cent to the weight of the bolts.

ESTIMATED WEIGHT OF METALS.

Pounds per Square Foot.

Thickness.	Wrought Iron.	Cast Iron.	Steel.	Copper.	Brass.	Lead.	Zinc.
$\frac{1}{16}$ in	2.51	2.34	2.55	2.89	2.67	3.69	2.34
$\frac{1}{8}$ "	5.03	4.69	5.10	5.78	5.35	7.38	4.68
$\frac{3}{16}$ "	5.55	7.03	7.66	8.67	8.02	11.07	7.02
$\frac{1}{4}$ "	10.07	9.38	10.21	11.56	10.7	14.76	9.36
$\frac{5}{16}$ "	12.58	11.73	12.76	14.45	13.37	18.45	11.7
$\frac{3}{8}$ "	15.10	14.07	15.31	17.34	16.05	22.14	14.04
$\frac{7}{16}$ "	17.62	16.42	17.87	20.23	18.72	25.83	16.34
$\frac{1}{2}$ "	20.14	18.77	20.42	23.12	21.4	29.53	18.72
$\frac{9}{16}$ "	22.65	21.11	22.97	26.01	24.07	33.22	21.08
$\frac{5}{8}$ "	25.17	23.46	25.52	28.90	26.75	36.91	23.44
$\frac{11}{16}$ "	27.69	25.81	28.08	31.97	29.42	40.60	25.80
$\frac{3}{4}$ "	30.21	28.15	30.63	34.68	32.1	44.29	28.13
$\frac{13}{16}$ "	32.72	30.50	33.18	37.57	35.19	47.98	30.49
$\frac{7}{8}$ "	35.24	32.85	35.73	40.69	38.28	51.67	32.81
$\frac{15}{16}$ "	37.76	35.19	38.28	43.35	41.37	55.37	35.17
1	40.28	37.54	40.83	46.25	43.75	59.06	37.50

AVERAGE WEIGHTS AND USUAL SIZES OF SPRINGS.

ELLIPTICS.

Weights and capacities given here are not absolutely correct, but from them a fair estimate may be made.

Width, Inches.	No. Plates.	Lengths, Inches.	Thickness of Plates.	Combined Thickness, Inches.	Estimate Weight per set, lbs.	Estimate Capacity, lbs.
1¼	2	28	5 6	13/32	15	160
1¼	2	30	4 5	7/16	17	200
1¼	2	32	3 4	15/32	18	185
1¼	2	32	4 5	7/16	16	180
1¼	2	34	3 3	½	20	220
1¼	2	34	3 4	15/32	19	195
1¼	2	36	3 3	½	21	200
1¼	2	36	3 4	15/32	20	185
1¼	3	32	3 4 4	23/32	26	260
1¼	3	32	3 4 5	45/64	25	240
1¼	3	34	3 3 3	¾	28	280
1¼	3	34	3 4 4	23/32	27	260
1¼	3	36	3 3 3	¾	30	260
1¼	3	36	3 4 4	23/32	29	345
1¼	4	34	3 3 3 3	1	35	360
1¼	4	34	3 4 4 4	61/64	34	340
1¼	4	34	3 4 5 5	59/64	33	330
1¼	4	36	2 3 3 3	1 1/32	39	345
1¼	4	36	3 3 3 3	1	38	340
1¼	4	36	3 4 4 4	61/64	35	325
1¼	5	34	2 3 3 3 3	1 9/32	43	440
1¼	5	34	3 3 3 3 3	1¼	41	420
1¼	5	34	3 4 4 4 4	1 3/16	38	440
1¼	5	34	3 4 5 5 5	1 9/64	27	435
1¼	5	36	2 3 3 3 3	1 9/32	46	420
1¼	5	36	3 3 3 3 3	1¼	45	400
1¼	5	36	3 4 4 4 4	1 3/16	41	430
1¼	5	36	3 4 5 5 5	1 9/64	40	400
1¼	5	38	2 3 4 4 4	1 3/16	42	480
1⅜	3	34	3 3 3	¾	31	300
1⅜	3	34	3 4 4	23/32	24	295
1⅜	3	36	3 3 3	¾	32	280
1⅜	3	36	3 4 4	23/32	31	275
1⅜	4	34	3 3 3 3	1	39	380
1⅜	4	34	3 4 4 4	61/64	36	375
1⅜	4	36	3 3 3 3	1	40	360
1⅜	4	36	3 4 4 4	61/64	37	355
1⅜	5	36	2 3 3 3 3	1 9/32	50	365
1⅜	5	36	3 3 3 3 3	1¼	47	360
1⅜	5	36	3 4 4 4 4	1 3/16	43	340
1½	3	34	3 3 3	¾	34	320
1½	3	34	3 4 4	23/32	31	315
1½	3	36	3 3 3	¾	35	300
1½	3	36	3 4 4	23/32	33	295
1½	4	34	3 3 3 3	1	42	400
1½	4	34	3 4 4 4	61/64	38	395
1½	4	36	2 3 3 3	1 1/32	47	385

ELLIPTICS.—Continued.

Width, Inches.	No. Plates.	Lengths, Inches.	Thickness of Plates.	Combined Thickness, Inches.	Estimate Weight per set, lbs.	Estimate Capacity, lbs.
$1\frac{1}{2}$	4	36	3 3 3 3	1	44	380
$1\frac{1}{2}$	4	36	3 4 4 4	$\frac{61}{64}$	41	375
$1\frac{1}{2}$	4	38	2 3 3 3	$1\frac{1}{32}$	50	375
$1\frac{1}{2}$	4	38	3 3 3 3	1	47	370
$1\frac{1}{2}$	4	38	3 4 4 4	$\frac{61}{64}$	43	365
$1\frac{1}{2}$	5	34	2 3 3 3 3	$1\frac{9}{32}$	55	465
$1\frac{1}{2}$	5	36	2 3 4 4 4	$1\frac{15}{64}$	52	455
$1\frac{1}{2}$	5	36	3 4 4 4 4	$1\frac{3}{16}$	49	440
$1\frac{1}{2}$	5	38	2 3 3 3 3	$1\frac{9}{32}$	59	455
$1\frac{1}{2}$	5	38	2 3 4 4 4	$1\frac{15}{64}$	56	445
$1\frac{1}{2}$	5	38	3 4 4 4 4	$1\frac{3}{16}$	50	430
$1\frac{1}{2}$	6	36	2 3 3 3 3 3	$1\frac{9}{16}$	63	570
$1\frac{1}{2}$	6	36	2 3 3 4 4 4	$1\frac{31}{64}$	61	550
$1\frac{1}{2}$	6	38	2 3 3 3 3 3	$1\frac{9}{16}$	68	545
$1\frac{1}{2}$	6	38	2 3 3 4 4 4	$1\frac{31}{64}$	64	540
$1\frac{3}{4}$	4	36	2 3 3 3	$1\frac{1}{32}$	54	445
$1\frac{3}{4}$	4	36	2 3 4 4	$1\frac{1}{64}$	51	440
$1\frac{3}{4}$	4	36	3 3 3 3	1	50	435
$1\frac{3}{4}$	4	36	3 4 4 4	$\frac{61}{64}$	46	430
$1\frac{3}{4}$	4	38	2 3 3 3	$1\frac{1}{32}$	56	425
$1\frac{3}{4}$	4	38	2 3 4 4	$1\frac{1}{64}$	54	420
$1\frac{3}{4}$	4	38	3 3 3 3	1	53	415
$1\frac{3}{4}$	4	38	3 4 4 4	$\frac{61}{64}$	48	430
$1\frac{3}{4}$	5	36	2 3 3 3 3	$1\frac{9}{32}$	62	530
$1\frac{3}{4}$	5	36	2 3 3 4 4	$1\frac{7}{32}$	59	510
$1\frac{3}{4}$	5	36	3 4 4 4 4	$1\frac{3}{16}$	54	485
$1\frac{3}{4}$	5	38	2 3 3 3 3	$1\frac{9}{32}$	65	510
$1\frac{3}{4}$	5	38	2 3 3 4 4	$1\frac{7}{32}$	64	490
$1\frac{3}{4}$	5	38	3 4 4 4 4	$1\frac{3}{16}$	57	495
$1\frac{3}{4}$	6	36	2 2 2 3 3 3	$1\frac{41}{64}$	76	595
$1\frac{3}{4}$	6	36	2 3 3 3 3 3	$1\frac{9}{16}$	71	600
$1\frac{3}{4}$	6	36	2 3 3 4 4 4	$1\frac{31}{64}$	68	580
$1\frac{3}{4}$	6	38	2 2 2 3 3 3	$1\frac{41}{64}$	82	585
$1\frac{3}{4}$	6	38	2 3 3 3 3 3	$1\frac{9}{16}$	76	585
$1\frac{3}{4}$	6	38	2 3 3 4 4 4	$1\frac{41}{64}$	74	580
2	5	36	2 3 3 3 3	$1\frac{9}{32}$	71	560
2	5	38	2 3 3 4 4	$1\frac{7}{32}$	69	540
2	5	38	2 3 3 3 3	$1\frac{9}{32}$	76	570
2	5	38	2 3 3 4 4	$1\frac{7}{32}$	74	550
2	6	36	2 2 2 3 3 3	$1\frac{41}{64}$	88	580
2	6	36	2 3 3 3 3 3	$1\frac{9}{16}$	81	670
2	6	38	2 2 2 3 3 3	$1\frac{41}{64}$	95	650
2	6	38	2 3 3 3 3 3	$1\frac{9}{16}$	88	640
2	7	36	2 2 2 3 3 3 3	$1\frac{57}{64}$	99	780
2	7	36	2 2 3 3 3 3 3	$1\frac{13}{16}$	92	760
2	7	38	2 2 2 3 3 3 3	$1\frac{52}{64}$	105	750
2	7	38	2 3 3 3 3 3 3	$1\frac{13}{16}$	98	730

PLATFORMS.

Width.	No. Plates. Sides.	No. Plates. Cross.	Lengths. Sides.	Lengths. Cross.	Estimate Weight per set.	Estimate Capacity.	Width.	No. Plates. Sides.	No. Plates. Cross.	Lengths. Sides.	Lengths Cross.	Estimate Weight per set.	Estimate Capacity.
1¼	3	4	38	42	62	475	2	5	6	40	44	150	1700
1¼	4	5	38	42	72	600	2	6	7	40	42	160	2400
1⅜	3	4	38	42	70	525	2	6	7	40	44	170	2600
1⅜	4	5	38	42	75	750	2	7	8	40	42	195	2800
1½	4	5	38	42	85	950	2	7	8	40	44	210	2700
1½	4	5	40	42	90	925	2¼	7	8	42	44	250	3000
1⅛	4	5	40	44	95	900	2⅛	7	8	42	44	275	3250
1½	5	6	38	42	95	1250	2½	8	9	42	44	295	3800
1½	5	6	40	42	100	1200	2½	9	10	42	44	315	4200
1½	5	6	40	42	105	1150	2½	10	11	42	44	330	4700
1½	6	7	40	42	115	1500	2¾	8	9	42	44	315	3900
1¾	4	5	40	42	115	1200	2¾	9	10	42	44	335	4500
1¾	5	6	40	42	125	1500	2¾	10	11	42	44	350	5000
1¾	5	6	40	44	130	1400	2¾	12	13	42	44	385	5500
1¾	6	7	40	42	145	2000	3	10	12	42	44	400	5500
1¾	6	7	40	44	150	1900	3	12	14	42	44	425	6000
2	5	6	40	42	145	1800	......	......	......	......	......	......	....

BOLSTER, OR HALF SPRINGS.

PLAIN END.

1½x3x42........................20 lbs. per pair.
1½x4x42........................23 " "
1½x5x42..................... .....27 " "
1¾x3x42........................23 " "
1¾x4x42..................... ...29 " "
1¾x5x42........................35 lbs. per pair
1¾x6x42........................38 " "
2 x4x42........................34 " "
2 x5x42........................40 " "
2 x6x42........................46 " "

CONCORD.

Width.	No. Plates.	Length.	Estimate. Weight.	Estimate Capacity.	Width.	No. Plates.	Length.	Estimate Weight.	Estimate Capacity.
1¼	4	50	28	250	1⅛	6	52	50	425
1¼	4	52	30	225	1⅛	6	54	55	410
1¼	5	50	35	325	1¾	4	50	38	400
1¼	5	52	38	300	1¾	4	52	43	385
1⅜	4	50	30	275	1¾	4	54	48	375
1⅜	4	52	34	260	1¾	5	50	45	450
1⅜	5	50	37	350	1¾	5	52	48	440
1⅜	5	52	40	325	1¾	5	54	53	430
1½	4	50	32	325	1¾	6	54	60	475
1½	4	52	35	300	2	5	54	60	550
1½	5	50	38	375	2	5	56	63	525
1½	5	52	40	360	2	6	56	70	650
1½	5	54	45	350	2	6	60	75	600

COACH PLATFORM.

1¼x3 and 3x34 and 32..34 lbs. per set.
1¼x4 and 4x36 and 34..41 " "
1¼x5 and 5x36 and 34..38 " "
1½x3 and 3x36 and 34..42 " "
1½x4 and 4x36 and 34..50 " "
1½x5 and 5x38 and 36..59 " "
1¾x5 and 5x40 and 38..,...................... ....73 " "

LIST OF SIZES AND APPROXIMATE WEIGHTS.

CONCORD AXLES.			COMMON AXLES.		
Size of Bed.	Length of Box.	Weight per Set.	Size of Bed.	Length of Box.	Weight per Set.
1⅛ inches.	6½ inches.	47 pounds	1 inches.	6½ inches.	43 pounds
1⅛ "	7 "	49 "	1⅛ "	6½ "	56 "
1¼ "	6½ "	56 "	1⅛ "	7 "	58 "
1¼ "	7 "	57 "	1¼ "	7 "	71 "
1⅜ "	7 "	70 "	1¼ "	7½ "	75 "
1⅜ "	7½ "	73 "	1⅜ "	7½ "	86 "
1½ "	7½ "	84 "	1⅜ "	8 "	87 "
1½ "	8 "	88 "	1½ "	7½ "	98 "
1½ "	8½ "	90 "	1½ "	8 "	101 "
1⅝ "	8½ "	99 "	1½ "	8½ "	103 "
1⅝ "	9 "	102 "	1⅝ "	8½ "	121 "
1¾ "	9 "	125 "	1⅝ "	9 "	124 "
1¾ "	9½ "	127 "	1¾ "	9½ "	148 "
2 "	9½ "	167 "	1¾ "	10 "	150 "
2 "	10 "	169 "	1¾ "	10½ "	153 "
2¼ "	10½ "	223 "	2 "	10 "	200 "
2¼ "	11 "	230 "	2 "	10½ "	205 "
2½ "	10½ "	275 "	2¼ "	10½ "	250 "
2½ "	11 "	285 "	2¼ "	11 "	284 "
....	....	....	2½ "	11 "	301 "
....	....	....	2½ "	12 "	330 "
....	....	....	2¾ "	12 "	375 "
....	....	....	3 "	12 "	460 "

Above weights must not be considered the exact weight per set, but are given as an aid in making estimates on work. Always measure from the inside of flange of the nut to the inside of collar at the shoulder; this gives the length of box.

APPROXIMATE LOAD FOR AXLES

1 inch Axles	....	500 to 750	pounds.
1⅛ "	....	750 " 1000	"
1¼ "	....	1000 " 1500	"
1⅜ "	....	1500 " 1800	"
1½ "	....	2000 " 2500	"
1⅝ "	....	3000 " 3500	"
1¾ "	....	3500 " 4000	"
2 "	....	6000 " 7000	"
2¼ "	....	8000 " 9000	"
2½ "	....	10000 " 12000	"

Above are safe loads for Steel Axles where ordinary usage is given.

TABLE

Showing the Approximate weight in Pounds of 100 Machine Bolts. of Sizes Enumerated Below.

Length	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4
1½	3.7	6.0	9.0	15.2	19.6	27.5	34.3	54.3				
2	4.2	7.0	10.5	17.2	22.2	31.0	38.4	60.0	90.8			
2½	4.8	8.0	12.0	19.2	24.8	34.5	42.5	65.7	99.1	148.2	209.0	277.0
3	5.5	9.0	13.5	21.2	27.5	38.0	46.7	71.4	107.4	159.0	222.5	293.5
3½	6.1	10.0	15.0	23.2	30.1	41.5	50.8	77.1	115.7	169.8	236.0	310.0
4	6.8	11.0	16.5	25.2	32.8	45.0	55.0	82.8	124.0	180.6	249.5	326.5
4½	7.4	12.0	18.0	27.2	35.4	48.5	59.1	88.9	132.3	191.4	263.0	343.0
5	8.1	13.0	19.5	29.2	38.1	52.0	63.3	95.0	140.6	202.2	276.5	359.5
5½	8.7	14.0	21.0	31.2	40.7	55.5	67.4	101.1	148.9	213.0	290.0	376.0
6	9.4	15.0	22.5	33.2	43.4	59.0	71.6	107.2	157.2	223.8	303.5	392.5
6½	10.1	16.0	24.1	35.2	46.0	62.5	75.7	113.3	165.5	234.6	317.0	409.0
7	10.8	17.0	25.7	37.2	48.7	66.0	79.9	119.4	173.8	245.4	330.5	425.5
7½	11.5	18.0	27.3	39.2	51.3	69.5	84.0	125.5	182.1	256.2	344.0	442.0
8	12.2	19.0	28.9	41.2	54.0	73.0	88.2	131.6	190.4	267.0	357.5	458.5
9			32.1	45.2	59.5	80.0	96.5	143.8	207.0	288.6	385.5	493.0
10			35.3	49.2	65.0	87.0	104.8	156.0	223.6	310.2	413.5	527.5
11			38.5	53.2	70.5	94.0	113.1	168.2	240.2	331.8	441.5	562.0
12			41.7	57.2	76.0	101.0	121.4	180.4	256.8	353.4	469.5	596.5
13					81.5	108.0	129.7	192.6	273.4	375.0	497.5	631.0
14					87.0	115.0	138.0	204.8	290.0	396.6	525.5	665.5
15					92.5	122.0	146.3	217.0	306.6	418.2	553.5	700.0
16					98.0	129.0	154.6	229.2	323.2	439.8	581.5	734.5
17					103.5	136.0	162.9	241.4	339.8	461.4	609.5	769.0
18					109.0	143.0	171.2	253.6	356.4	483.0	637.5	803.5
19					114.5	150.0	179.5	265.8	373.0	504.6	665.5	838.0
20					120.0	157.0	187.8	278.0	389.6	526.2	693.5	872.5
21								290.4	406.5	548.2	721.5	907.0
22								302.8	423.4	570.2	749.5	941.5
23								315.2	440.3	592.2	777.5	976.0
24								327.6	457.2	614.2	805.5	1010.5
25								340.0	474.1	636.2	833.5	1045.0
26								352.4	491.0	658.2	861.5	1079.5
27								364.8	507.9	680.2	889.5	1114.0
28								377.2	524.8	702.2	917.5	1148.5
29								389.6	541.7	724.2	945.5	1183.0
30								402.0	558.6	746.2	973.5	1217.5

Flat and Round Head Stove Bolts.

Number of Papers in a Case and Number of Bolts in a Keg.

APPROXIMATELY.

Size.	5/32 Inch.		3/16 Inch.		7/32 Inch.		1/4 Inch.		5/16 Inch.		3/8 Inch.	
	Case.	Keg.	Case.	Keg.	Case.	Keg.	Case.	Keg.	Case.	Keg.	Case.	Keg.
3/8	518	13000	366	12000								
1/2	402	12000	336	10000	260	9500	224	9000				
5/8	366	11000	290	9000	234	8500	190	8000				
3/4	336	10000	260	8000	224	7500	180	7000	100	4800	90	3500
7/8	290	9000	245	7500	190	7000	175	6500	90	4500	70	3200
1	260	8000	234	7000	180	6500	150	6000	90	4000	62	3000
1 1/8	234	7500	224	6500	180	6000	135	5500	90	3800	62	2700
1 1/4	234	7000	190	6000	180	5500	135	5000	90	3500	60	2500
1 3/8	245	6500	180	5500	150	5000	120	4800	70	3200	60	2200
1 1/2	245	6000	175	5000	150	4800	113	4500	62	3000	60	2100
1 3/4	190	5000	150	4000	140	4500	90	4000	60	2700	60	2000
2	180	4000	140	3000	108	4000	90	3500	60	2300	59	1700
2 1/4	150	3500	115	3000	100	3500	70	3000	59	2000	40	1500
2 1/2	....	....	108	2800	90	3000	60	2800	45	1800	40	1400
2 3/4	....	....	90	2500	90	2800	53	2500	40	1600	40	1200
3	....	....	90	2000	90	2500	59	2000	40	1300	40	1000
3 1/4	....	....	90	....	59	....	59	2000	30	1300	30	1000
3 1/2	....	....	90	....	59	....	59	1800	30	1200	30	900
3 3/4	....	....	70	....	....	....	40	1800	30	1100	30	900
4	....	....	59	....	....	....	40	1500	30	900	24	750
4 1/4	....	....	59	....	....	....	30	1200	30	800	24	650
4 1/2	....	....	59	....	....	....	30	1200	30	800	24	600
4 3/4	....	....	59	....	....	....	30	1200	30	800	24	550
5	....	....	59	....	....	....	30	1000	24	700	24	500
5 1/4	....	....	....	....	....	....	30	1000	24	700	24	470
5 1/2	....	....	....	....	....	....	30	1000	24	660	20	450
5 3/4	....	....	....	....	....	....	24	1000	24	600	20	420
6	....	....	....	....	....	....	24	800	24	530	20	400
6 1/4	....	....	....	....	....	....	24	800	20	500	20	370
6 1/2	....	....	....	....	....	....	24	800	20	500	20	350

Tire Bolts.

Number of Papers in a Case.

Philadelphia.

Size.	1/8	3/16	7/32	1/4	5/16	3/8
	Papers.	Papers.	Papers.	Papers.	Papers.	Papers.
1 Inch.	260	224	180	135		
1¼ "	234	190	180	108	90	62
1½ "	224	180	150	100	62	59
1¾ "	180	150	140	90	60	59
2 "	180	135	108	90	60	59
2¼ "	150	89	95	68	59	50
2½ "	....	90	90	60	40	50
2¾ "	....	90	90	56	40	40
3 "	....	90	62	59	30	40
3¼ "	....	68	59	59	30	40
3½ "	....	59	59	59	30	40
3¾ "	....	68	....	59	30	30
4 "	....	62	....	59	30	30
4¼ "	....	....	....	40	25	30
4½ "	....	....	....	40	25	30
4¾ "	....	....	....	40	24	24
5 "	....	....	....	30	24	24
5¼ "	....	....	....	30	24	24
5½ "	....	....	....	24	24	20
5¾ "	....	....	....	24	24	20
6 "	....	....	....	24	24	20

Bay State.

Size.	3/16	1/4	5/16	3/8
	Papers.	Papers.	Papers.	Papers.
1 Inch.	260	184		
1¼ "	224	150		
1½ "	190	140		
1¾ "	184	115	90	59
2 "	135	108	70	59
2¼ "	108	90	62	59
2½ "	100	90	59	40
2¾ "	90	70	59	40
3 "	90	62	59	40
3¼ "	70	59	59	30
3½ "	59	59	59	30
3¾ "	59	59	40	30
4 "	59	59	40	30
4¼ "	....	59	32	30
4½ "	....	40	32	24
4¾ "	....	40	30	24
5 "	....	30	30	24
5¼ "	....	30	24	24
5½ "	....	24	24	24
5¾ "	....	24	24	20
6 "	....	24	24	20

TABLE

Showing the Average Weight in Pounds of 100 Common Carriage Bolts, of Sizes Enumerated.

Length.	1/4	5/16	3/8	7/16	1/2	5/8
1	2.8	4.8	6.9	9.4	14.5	28.0
1¼	3.1	5.2	7.6	10.4	15.9	30.0
1½	3.4	5.7	8.3	11.4	17.3	32.0
1¾	3.7	6.1	9.0	12.4	18.6	34.0
2	3.0	6.6	9.7	13.3	20.0	36.0
2¼	4.4	7.0	10.4	14.3	21.4	38.0
2½	4.7	7.5	11.1	15.3	22.8	40.0
2¾	5.0	7.9	11.8	16.3	24.2	42.0
3	5.3	8.4	12.5	17.3	25.5	44.0
3½	5.9	9.3	13.9	19.3	28.3	48.0
4	6.6	10.2	15.3	21.3	31.0	52.0
4½	7.2	11.1	16.7	23.3	33.8	56.0
5	7.8	12.0	18.0	25.3	36.5	60.0
5½	8.4	12.9	19.4	27.3	39.3	64.0
6	9.0	13.8	20.8	29.3	42.0	68.0
6½	9.7	14.7	21.2	31.2	44.8	72.0
7	10.3	15.6	23.6	33.2	47.5	76.0
7½	10.9	16.5	25.0	35.2	50.3	80.0
8	11.6	17.4	26.4	37.2	53.0	84.0
8½	......	18.4	27.8	39.2	55.8	88.0
9	......	19.3	29.2	41.2	58.5	92.0
9½	......	20.2	30.6	43.1	61.3	96.0
10	......	21.0	32.0	45.1	64.0	100.0
10½	......	......	33.4	47.1	66.8	104.0
11	......	......	34.8	49.1	69.5	108.0
11½	......	......	36.2	51.0	72.3	112.0
12	......	......	37.5	53.0	75.0	116.0

COACH SCREWS, LAG SCREWS AND SKEIN SCREWS.

Average Weight of One Hundred.

Diam.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Length.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1½	2.7	3.5	5.8	9.1	......	......	......	......	......	......
2	3.5	4.4	7.1	11.0	15.0	22.8	26.3	......	......	......
2½	4.2	5.3	8.5	12.9	17.3	25.3	29.9	......	......	......
3	4.7	6.2	9.8	14.8	19.5	27.8	33.5	46.1	71.8	103.0
3½	5.2	7.1	11.1	16.5	21.6	30.4	37.1	51.5	78.6	112.0
4	5.7	8.0	12.5	18.2	23.8	33.0	40.7	57.1	85.3	121.0
4½	6.5	9.0	13.8	19.9	26.3	35.5	44.5	62.9	92.0	130.0
5	7.0	10.0	14.9	21.8	28.8	38.0	48.3	68.8	98.6	141.0
5½	7.5	11.0	16.0	23.5	31.3	40.7	52.0	74.7	105.3	153.0
6	8.0	12.0	17.2	25.2	33.8	43.3	55.7	80.5	112.0	164.0
7	......	......	......	......	38.9	50.0	63.2	92.3	125.4	185.0
8	......	......	......	......	44.0	56.8	69.3	104.0	138.8	205.0
9	......	......	......	......	48.5	63.5	76.4	115.4	156.3	225.0
10	......	......	......	......	53.0	70.3	83.5	126.8	173.8	245.0
11	......	......	......	......	57.5	77.0	90.6	138.2	191.3	265.0
12	......	......	......	......	62.0	83.7	97.8	149.5	208.8	285.0

TABLE SHOWING THE APPROXIMATE NUMBER OF OVAL HEAD RIVETS PER POUND.

Length, Inch.	Wire. 3/8	Wire. 5/16	Wire. 1/4	Wire. No. 5.	Wire. No. 6.	Wire. 3/16	Wire. No. 7.	Wire. No. 8.
½	28	48	83	96	130	150	160	210
¾	24	39	62	84	104	125	136	160
⅞	22	31	55	75	91	108	116	142
1	20	28	50	64	83	94	102	125
1¼	18	26	43	52	68	80	88	110
1½	16	22	38	46	62	71	75	96
1¾	14	20	33	42	54	64	67	83
2	13	18	29	37	48	56	60	72
2¼	12	16	25	34	41	48	52	66
2½	11	15	23	32	37	44	47	57
2¾	10	14	21	30	34	40	43	52
3	9	13	20	28	21	37	39	48
3¼	9	12	19	27	29	35	37	46
3½	8	12	18	25	27	33	35	44
3¾	7	11	17	23	26	32	34	43
4	7	10	16	22	25	31	33	41

THOUSAND RIVETS.

APPROXIMATE DIMENSIONS.

Size.	Length.	Diam. Wire Gauge.	Size.	Length	Diam. Wire Gauge.
8 Ounce.	5/32	No. 13½	3½ Pound.	21/64	No. 8
10 "	11/64	" 13	4 "	11/32	" 7½
12 "	3/16	" 12¼	5 "	3/8	" 6¾
14 "	3/16	" 12	6 "	25/64	" 6
1 Pound.	13/64	" 11¾	7 "	13/32	" 5¼
1¼ "	7/32	" 11	8 "	7/16	" 4¾
1½ "	15/64	" 10½	9 "	29/64	" 4½
1¾ "	1/4	" 10	10 "	15/32	" 4
2 "	17/64	" 9¼	12 "	1/2	" 3
2½ "	9/32	" 9	14 "	33/64	" 2
3 "	5/16	" 8¼	16 "	17/32	" 1

Gimlet Pointed Coach Screws.

Number in one Keg of 150 Pounds.

APPROXIMATELY.

Size.	¼	5/16	⅜	7/16	½	9/16	⅝	¾	⅞	1
1½	100 5000	100 3000	100 2300	50 1520	50 1200					
2	100 4300	100 2500	100 1850	50 1400	50 935	25 770	25 600			
2½	100 3300	100 2200	50 1590	50 1210	50 820	25 760	25 500			
3	100 3000	100 2100	50 1455	50 1000	25 750	25 650	25 475	25 316		
3½	100 2700	100 1850	50 1300	25 835	25 675	25 550	25 430	25 286		
4	100 2500	50 1650	50 1150	25 865	25 620	25 467	25 390	25 255		
4½	100 2300	50 1500	50 1050	25 790	25 560	25 450	25 360	25 225		
5	100 2175	50 1400	25 960	25 710	25 520	25 414	25 325	25 210	153	122
5½	....	...	25 930	25 675	25 470	25 372	25 306	25 200	142	114
6	....	...	25 855	25 625	25 440	25 351	25 285	25 190	132	104
7	....	....	25 750	25 530	25 395	25 320	25 260	25 163	120	90
8	....	....	620	465	350	280	218	143	105	81
9	....	....	....	....	303	250	192	128	98	74
10	....	....	....	....	268	215	178	118	88	67
11	....	....	....	....	251	180	159	107	82	63
12	....	....	....	....	234	162	146	97	71	60

The Small Figures indicate the Number of Screws in One Paper Package.

Patent Iron Wood Screws.

Number of Gross in a Case.

¼ Inch.

No.	Gro.
0	480
1	480
2	360
3	480
4	450

⅜ Inch.

No.	Gro.
0	480
1	380
2	480
3	450
4	450
5	360
6	300
7	200
8	200
9	200

½ Inch.

No.	Gro.
1	480
2	450
3	450
4	360
5	300
6	200
7	200
8	200
9	200
10	200
11	200
12	200

⅝ Inch.

No.	Gro.
1	480
2	450
3	360
4	300
5	200
6	200
7	200
8	200
9	200
10	200
11	200
12	200
13	200
14	200

¾ Inch.

No.	Gro.
2	360
3	300
4	200
5	200
6	200
7	300
8	300
9	200
10	200
11	200
12	200
13	200
14	200
15	180
16	180

⅞ Inch.

No.	Gro.
2	300
3	200
4	200
5	200
6	200
7	200
8	200
9	200
10	200
11	200
12	200
13	200
14	180
15	180
16	180

1 Inch.

No.	Gro.
3	200
4	200
5	200
6	200
7	200
8	200
9	300
10	300
11	200
12	200
13	180
14	180
15	180
16	180
17	100
18	100
20	100

1¼ Inch.

No.	Gro.
4	200
5	200
6	200
7	200
8	200
9	200
10	240
11	240
12	180
13	180
14	180
15	100
16	100
17	100
18	100
20	100
22	90
24	90

1½ Inch.

No.	Gro.
4	200
5	200
6	200
7	200
8	200
9	180
10	180
11	180
12	180
13	100
14	100
15	100
16	100
17	100
18	100
20	90
22	90
24	50

1¾ Inch.

No.	Gro.
6	180
7	180
8	180
9	180
10	180
11	100
12	100
13	100
14	100
15	100
16	100
17	90
18	90
20	90
22	48
24	48

2 Inch.

No.	Gro.
6	180
7	180
8	180
9	100
10	100
11	100
12	100
13	100
14	100
15	90
16	90
17	90
18	90
20	48
22	48
24	48

2¼ Inch.

No.	Gro.
8	100
9	100
10	100
11	100
12	100
13	90
14	90
15	90
16	90
17	48
18	48
20	48
22	48
24	36

2½ Inch.

No.	Gro.
8	100
9	100
10	100
11	90
12	90
13	90
14	90
15	50
16	50
17	50
18	48
20	48
22	36
24	36

2¾ Inch.

No.	Gro.
10	48
11	50
12	50
13	50
14	50
15	50
16	50
17	48
18	48
20	48
22	36
24	36
26	36

3 Inch.

No.	Gro.
10	50
11	50
12	48
13	50
14	50
15	50
16	48
17	48
18	48
20	36
22	36
24	36
26	24

3½ Inch.

No.	Gro.
10	48
11	48
12	50
13	50
14	48
15	48
16	48
17	48
18	36
20	36
22	36
24	36
26	20

4 Inch.

No.	Gro.
12	48
14	48
16	36
18	36
20	36
22	36
24	24
26	20

4½ Inch.

No.	Gro.
16	36
18	36
20	36
22	24
24	24
26	20

5 Inch.

No.	Gro.
13	24
20	24
22	24
24	20
26	20
28	12

6 Inch.

No.	Gro.
20	20
22	20
24	10
26	12
28	12
30	12

Patent Iron Wood Screws.

Weight per Gross.

APPROXIMATELY.

¼ Inch.

No.	Pounds.
0	.0260
1	0391
2	0562
3	0764
4	.0992

⅜ Inch.

No.	Pounds.
0	.0366
1	.0545
2	.0773
3	1039
4	1331
5	1677
6	2031
7	2492
8	3009
9	3585

½ Inch.

No.	Pounds.
1	.0694
2	.0978
3	1303
4	1654
5	.2056
6	.2560
7	3128
8	3762
9	.4464
10	5237
11	.6084
12	.7006

⅝ Inch.

No.	Pounds.
1	.0840
2	.1177
3	.1557
4	.1959
5	.2489
6	.3089
7	.3763
8	.4514
9	.5342
10	.6252
11	.7244
12	.8322
13	.9488
14	1.0744

¾ Inch.

No.	Pounds.
2	.1369
3	1801
4	.2304
5	.2921
6	.3618
7	.4399
8	.5266
9	.6221
10	7266
11	.8404
12	.9638
13	1.0969
14	1.2400
15	1.3934
16	1.5574

⅞ Inch.

No.	Pounds.
2	.1554
3	.2034
4	.2649
5	.3353
6	.4147
7	.5035
8	.6018
9	.7099
10	.8281
11	.9565
12	1.0954
13	1.2451
14	1.4057
15	1.5776
16	1.7610

1 Inch.

No.	Pounds.
3	.2302
4	.2994
5	.3785
6	.4676
7	.5671
8	.6770
9	.7978
10	.9295
11	1.0725
12	1.2270
13	1.3932
14	1.5714
15	1.7617
16	1.9647
17	2.1800
18	2.4084
20	2.9047

1¼ Inch.

No.	Pounds.
4	.3684
5	4649
6	.5734
7	.6942
8	.8275
9	.9734
10	1.1324
11	1.3046
12	1.4902
13	1.6895
14	1.9027
15	2.1300
16	2.3720
17	2.6282
18	2.8994
20	3.4875
22	4.1378
24	4.8524

1½ Inch.

No.	Pounds.
4	.4374
5	5514
6	.6792
7	8213
8	9779
9	1.1491
10	1.3353
11	1.5367
12	1.7534
13	1.9858
14	2.2340
15	2.4984
16	2.7793
17	3.0764
18	3.3905
20	4.0702
22	4.8200
24	5.6419

1¾ Inch.

No.	Pounds.
6	.7850
7	.9485
8	1.1283
9	1.3248
10	1.5382
11	1.7687
12	2.0166
13	2.2821
14	2.5653
15	2.8667
16	3.1865
17	3.5246
18	3.8816
20	4.6529
22	5.5022
24	6.4313

2 Inch.

No.	Pounds.
6	.8908
7	1.0756
8	1.2788
9	1.5005
10	1.7411
11	2.0008
12	2.2798
13	2.5784
14	2.8966
15	3.2350
16	3.5938
17	3.9728
18	4.3727
20	5.2356
22	6.1843
24	7.2208

2¼ Inch.

No.	Pounds.
8	1.4292
9	1.6762
10	1.9440
11	2.2329
12	2.5430
13	2.8747
14	3.2280
15	3.6034
16	4.0011
17	4.4210
18	4.8638
20	5.8183
22	6.8665
24	8.0103

2½ Inch.

No.	Pounds.
8	1.5796
9	1.8519
10	2.1469
11	2.4649
12	2.8062
13	3.1710
14	3.5593
15	3.9717
16	4.4084
17	4.8692
18	5.3549
20	6.4010
22	7.5487
24	8.7998

2¾ Inch.

No.	Pounds.
10	2.3498
11	2.6970
12	3.0694
13	3.4673
14	3.8906
15	4.3400
16	4.8157
17	5.3052
18	5.8460
20	6.9838
22	8.2309
24	9.5893
26	11.0607

3 Inch.

No.	Pounds.
10	2.5527
11	2.9291
12	3.3326
13	3.7636
14	4.2220
15	4.7084
16	5.2230
17	5.7656
18	6.3370
20	7.5665
22	8.9131
24	10.3787
26	11.9653

3½ Inch.

No.	Pounds.
10	2.9585
11	3.3932
12	3.8599
13	4.3561
14	4.8846
15	5.4450
16	6.0376
17	6.6620
18	7.3192
20	8.7319
22	10.2774
24	11.9577
26	13.7745

4 Inch.

No.	Pounds.
12	4.3854
14	5.5473
16	6.8522
18	8.3014
20	9.8973
22	11.6418
24	13.5366
26	15.5837

4½ Inch.

No.	Pounds.
16	7.6667
18	9.2836
20	11.0628
22	13.0061
24	15.1156
26	17.3929

5 Inch.

No.	Pounds.
18	10.2657
20	12.2282
22	14.3705
24	16.6945
26	19.2021
28	21.8952

6 Inch.

No.	Pounds.
20	14.5590
22	17.0992
24	19.8525
26	22.8205
28	26.0054
30	29.4091

For weight of Brass Screws, add $7\frac{9}{10}$ per cent. to these weights.

Standard Penny Steel Wire Nails.

Sizes, Lengths and Approximate Number per Pound.

Sizes.	Length.	Common.	Barbed Common.	Clinch.	Fence.	Finishing.	Barbed Finishing.	Fine.	Barrel.	Casing	Smooth Box	Barbed Box	Flooring Brads.	Barbed Oval Head Car Nails. Light.	Barbed Oval Head Car Nails. Heavy.	Slating.	Barbed Roofing.	Shingle.	Tobacco.	Lining.	Wire Spikes.	Length.	Sizes.
	¾	...	...	...	...	...	...	...	940	...	...	...	...	...	...	...	648	...	...	1930	...	¾	
	⅞	...	...	...	...	...	...	...	804	...	...	...	...	...	...	...	413	...	...	1660	...	⅞	
2d ..	1	900	860	622	...	1558	1558	1440	620	1140	1000	1000	...	...	...	385	384	...	...	1440	...	1	2d .
3d Fine	1⅛	...	...	...	...	...	...	810	590	...	...	...	...	...	...	...	339	...	...	...	...	1⅛	3d Fine
3d Com	1¼	615	594	412	...	884	884	...	542	675	660	660	...	...	...	230	231	380	...	...	...	1¼	3d Com
	1⅜	...	...	...	...	...	...	...	365	...	...	...	...	...	...	...	...	...	...	...	...	1⅜	
4d ..	1½	322	339	267	...	767	767	550	322	567	550	550	...	260	164	198	154	256	256	...	...	1½	.. 4d
5d ..	1¾	250	230	230	127	491	491	...	...	396	366	366	...	134	103	125	135	226	226	...	...	1¾	.. 5d
6d ..	2	200	205	156	114	359	359	...	...	260	250	250	151	119	91	112	90	200	145	...	...	2	.. 6d
7d ..	2¼	154	135	110	88	317	317	...	...	239	236	236	136	85	73	...	...	130	130	...	...	2¼	.. 7d
8d ..	2½	106	96	98	74	214	214	...	...	160	157	157	98	75	65	...	...	120	100	...	...	2½	.. 8d
9d ..	2¾	85	92	86	58	195	195	...	...	148	145	145	86	58	51	...	...	115	85	...	...	2¾	.. 9d
10d ..	3	74	63	66	42	134	134	...	...	108	107	107	66	55	45	...	...	79	65	...	37	3	.. 10d
12d ..	3¼	57	52	57	36	120	120	...	...	99	98	98	51	43	38	...	...	...	...	...	...	3¼	.. 12d
16d ..	3½	46	38	46	28	91	91	...	...	69	65	65	40	39	34	...	...	...	...	...	29	3½	.. 16d
20d ..	4	29	30	35	22	61	61	...	...	50	45	45	29	31	26	...	...	...	...	...	23	4	.. 20d
30d ..	4½	23	23	...	...	...	...	...	...	45	40	40	...	27	23	...	...	...	...	...	18	4½	.. 30d
40d ..	5	17	17	...	...	...	...	...	...	35	30	30	...	21	17	...	...	...	...	...	13	5	.. 40d
50d ..	5½	13½	13½	...	...	...	...	...	...	...	...	...	...	18	14	...	...	...	...	...	10	5½	.. 50d
60d ..	6	10½	10½	...	...	...	...	...	...	...	...	...	...	15	13	...	...	...	...	...	9	6	.. 60d
	6½																				7½	6½	
	7																				6½	7	
	8																				4¼	8	
	9																				3⅔	9	
																					3¼	10	
																					2¾	12	

Miscellaneous Steel Wire Nails.

Approximate Number per Pound.

Wire Gauge.	3/16	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1½	1¾	2	2¼	2½	2¾	3	3½	4	4½	5	6	7	8	9	10
00	....	....	....	....	....	....	....	....	....	33	27	23	20	18	16	15	14	12	10	9	8	7	6	5	4½	4
⅜	....	....	....	....	....	....	....	....	....	33	27	23	20	18	16	15	14	12	10	9	8	7	6	5	4½	4
0	....	....	....	....	....	....	....	....	....	34	29	25	21	19	17	16	15	13	11	10	9	8	7	5½	5	4½
5/16	....	....	....	....	....	....	....	57	50	45	38	32	28	25	23	21	19	16	14	13	11	10	8	7	6	5½
2	....	....	....	....	....	....	....	65	58	52	44	37	32	29	26	24	22	19	16	14	13	11	9	8	7	6½
3	....	....	....	....	....	100	87	76	67	60	50	43	38	34	30	28	25	22	19	17	15	13	11	10	8	7½
4	....	....	....	....	....	120	104	90	80	72	60	51	45	40	36	33	30	26	23	20	18	15	13	11	10	9
5	....	....	....	211	169	141	121	106	94	85	71	60	53	47	42	39	35	30	26	24	21	18	15			
6	....	....	....	247	197	164	141	123	111	99	82	71	62	55	50	45	41	35	31	28	25	21	18			
7	....	....	....	299	239	200	171	149	133	120	100	85	75	67	60	54	50	43	37	33	30	25				
8	....	....	....	345	275	229	197	172	153	137	115	98	86	76	69	62	57	49	43	39	35	29				
9	....	....	....	414	331	276	236	207	184	165	138	118	103	92	82	75	69	59	52	46	41					
10	....	....	663	496	397	333	283	248	220	198	165	142	124	110	99	90	83	71	62	55	50					
11	....	....	837	628	502	418	359	314	279	251	209	179	157	139	125	114	105	90	79	70						
12	....	....	1096	822	658	548	469	411	365	329	274	235	204	182	164	149	137	117	103							
13	....	....	1429	1072	857	714	613	536	476	429	357	306	268	238	214	195	178	153								
14	....	2840	1893	1420	1136	947	811	710	631	568	473	406	350	315	284	258	236									
15	....	3504	2336	1752	1402	1168	1001	876	778	701	584	500	438	389	350											
16	....	4571	3048	2280	1828	1523	1305	1143	1015	913	761	653	571	508												
17	....	6233	4156	3116	2495	2077	1781	1558	1385	1246	1038	890	779													
18	....	8276	5517	4138	3310	2758	2364	2069	1839	1655	1379	1182														
19	....	10668	7112	5334	4267	3556	2933	2667	2370	2133	1778															
20	20000	15000	10000	7500	6000	5000	4400	3750	3333	3000																
21	23702	17777	11850	8888	7111	5926	5079	4444																		
22	30476	22856	15237	11428	9143	7618																				

Wire Gauge.	11	12
00	3¼	3¼
⅜	3¼	3¼
0	4	3½
5/16	5	4½
2	6	5½

These approximate numbers are an average only, and the figures given may be varied either way, by changes in the dimensions of heads or points.

Brads and no-head nails will run more to the pound than table shows, and large or thick headed nails will run less.

TABLE OF WHEEL PROPORTIONS.

The following proportions give the best service for general use:

PLAIN WOOD HUB WHEELS.

RIMS.			SPOKES.	HUBS.			STYLE OF FRONT.
TIRE.	DEPTH	DIAMETER.	SIZE.	DIAMETER.	LENGTH	SIZE OF MORTISE.	
As may be ordered. If not ordered differently, Rims will be sent square.	1	As may be ordered.	1	3 3/4 or 4	6 1/2	7/8x3/8	
	1 1/8		1 1/8	4 or 4 1/2	6 1/2	1 x7/16	Plain or double beaded, as may be ordered.
	1 1/4		1 1/4	5	7	1 1/8x1/2	
	1 3/8		1 3/8	5 1/2	7 1/2	1 1/4x1/2	
	1 1/2		1 1/2	6	8	1 3/8x9/16	
	1 5/8		1 5/8	6 1/2	8 1/2	1 1/2x5/8	
	1 3/4		1 3/4	7	9	1 5/8x5/8	
	1 7/8		1 7/8	7 1/2	9 1/2	1 3/4x11/16	
	2		2	8	10	1 7/8x3/4	
	2 1/8		2 1/8	8 1/2	10 1/2	2 x3/4	
	2 1/4		2 1/4	9	11	2 1/8x7/8	
	2 3/8		2 3/8	9 1/2	11 1/2	2 1/4x7/8	
	2 1/2		2 1/2	10	12	2 3/8x15/16	

WHEEL STUFF IN PAIRS, FOR CABS AND CARTS.

RIMS.	DIAM.	SPOKES, 30 INCH.	HUBS.
1 3/4x1 3/4	As ordered, 4 ft. 8 in. to 5 ft.	1 3/4	7 x 9 7 1/2x 9 1/2
1 3/4 or 2 x2		1 3/4 or 2	7 x 9 7 1/2x 9 1/2
2 or 2 1/4x2 1/4		2	8 x10
2 1/4 or 2 1/2x2 1/2		2 1/4	8 1/2x10 1/2 9 x11

HORSESHOES.

BURDEN.

Average Weight of Each Shoe.

	FRONT				HIND			
Size. No.	Ex. Light. oz.	Light. oz.	Medium. oz.	Heavy. oz.	Ex. Light. oz.	Light. oz.	Medium. oz.	Heavy. oz.
0	10½	12	..	....	09½	11	....	....
1	13	15	17	18½	11	13½	14½	15
2	14½	18	20	23	13	15	17	18
3	17½	20½	24	25½	15½	19	21	23½
4	21	25	28	32½	19	23½	23	27
5	26½	30	34	39	24	27	29	32
6	....	36	41	46	....	32	34½	38½
7	....	42	48	....	....	35	39	....
8	....	....	57	....	....	....	48	....

Average Number of Shoes in Each Keg.

0	152	133	..	....	168	145	....	....
1	123	107	90	86	145	111	113	107
2	113	89	80	69	123	107	94	89
3	91	78	66	62	103	84	76	68
4	76	64	57	46	84	68	70	59
5	60	53	47	41	66	59	55	50
6	....	44	39	35	....	50	46	42
7	....	38	33	....	....	46	41	....
8	....	....	28	....	....	....	33	....

AMERICAN.

Average Weight of Each Shoe.

0	10	12	....	....	8	10	....	....
1	12	14	17	19	10	12	13½	15
2	15½	17	20	23	13	14	16	18
3	18	20½	24½	27	16	18	20	23
4	22	24½	28½	33	19	22	24	27
5	25½	30	35½	39	23	26½	29	32
6	....	35½	40	44	....	31	34	37
7	....	41½	46	50	....	34	38	43
8	....	....	51	56	....	....	43	48

Average Number of Shoes in Each Keg.

0	160	133	....	....	200	160	....	....
1	133	114	90	84	160	133	111	107
2	103	94	80	70	123	114	100	89
3	89	78	65	59	100	89	80	70
4	73	65	56	49	84	73	66	59
5	62	53	46	41	69	60	55	50
6	....	45	40	36	....	51	47	43
7	....	38	35	32	....	47	42	37
8	....	....	31	29	....	....	37	33

HORSESHOES—Continued.

PERKINS.

Average Weight of Each Shoe.

FRONT.

Size. No.	Ex. Light. oz.	Light. oz.	Special. oz.	Medium. oz.	Heavy. oz.	Ex. Heavy. oz.	S. C. D. or Long Heel. oz.
0	10½	11	..	....	....	..	..
1	13	13½	..	17	....	20	..
2	16	17	..	21	23	25	..
3	19	20	25	25	28	29	..
4	22½	24½	30	30	31	34	31
5	26	30	35	35	36	..	38
6	34	38	39	41	....	..	46
7	....	44	48	47	....	..	50
8	....	....	51	53	....	..	..

HIND.

Size. No.	Ex. Light. oz.	Light. oz.	Special. oz.	Medium. oz.	Heavy. oz.	Ex. Heavy. oz.	S. C. D. or Long Heel. oz.
0	9	9	N	..	....	..	..
1	11	12½	O	14	....	18	..
2	14	15	T	17	19½	20	..
3	17	18	..	21	23½	24	..
4	21	23	M	24½	27	28	27
5	25	26	A	30	32	..	31
6	30	33	D	35	....	..	39
7	....	37	E	40	....	..	40
8	....	....	..	45	....	..	..

Average Number of Shoes in Each Keg.

FRONT.

Size. No.	Ex. Light.	Light.	Special.	Medium.	Heavy.	Ex. Heavy.	S. C. D. or Long Heel.
0	152	146	..	....	....	..	..
1	123	119	..	94	....	80	..
2	100	94	..	76	70	64	..
3	74	80	64	64	57	55	..
4	71	67	53	53	51	47	59
5	62	53	46	46	44	..	42
6	47	42	41	39	....	..	35
7	....	36	33	34	....	..	32
8	....	....	31	30	....	..	..

HIND.

Size. No.	Ex. Light.	Light.	Special.	Medium.	Heavy.	Ex. Heavy.	S. C. D. or Long Heel.
0	177	177	N	....	....	..	..
1	146	130	O	114	....	88	..
2	114	107	T	94	82	80	..
3	94	88	..	76	68	66	..
4	76	70	M	67	59	57	59
5	64	62	A	53	50	..	51
6	53	48	D	46	....	..	41
7	....	43	E	40	....	..	40
8	....	....	..	36	....	..	..

HORSESHOES—Continued.

PHOENIX.

Average Weight of Each Shoe.

	FRONT				HIND			
Size. No.	Ex. Light. oz.	Light. oz.	Medium. oz.	Heavy. oz.	Ex. Light. oz.	Light. oz.	Medium. oz.	Heavy. oz.
0	10	12	....	....	8	10	....	....
1	13	14	17	19	10½	12	14	15
2	15½	17	20	23	13	14	16	18
3	18½	21	25	27	16	18	20	23
4	22	25	29	33	19½	22	24	27
5	25½	30	35	39	23	27	29	32
6	30	36	42	46	27	31	34	37
7	....	43	49	....	....	34	38	....
8	....	....	56	....	....	....	45	....

Average Number of Shoes in Each Keg.

0	160	133	....	....	200	160	....	....
1	123	114	94	84	152	133	114	106
2	103	94	80	69	123	114	100	88
3	86	76	64	59	100	88	80	70
4	72	64	55	48	82	73	66	59
5	64	52	46	41	70	59	55	50
6	53	44	38	34	59	51	47	43
7	....	37	33	....	....	47	42	....
8	....	....	28	....	....	....	35	....

HORSE SHOE NAILS.

STAR.

Standard Sizes and Weights per Pound.

No. of Nail	3	4	5	6
Length of Nail, Regular or Country Head, in inches	...	...	$2^{1}/_{16}$	$2^{3}/_{16}$
Length of Nail, Small or City Head, in inches	$1^{5}/_{8}$	$1^{7}/_{8}$	$1^{15}/_{16}$	$2^{1}/_{8}$
Number in a Pound, Country Head	...	...	187	145
Number in a Pound, City Head	...	...	193	156

No. of Nail	7	8	9	10
Length of Nail, Regular or Country Head, in inches	$2^{5}/_{16}$	$2^{1}/_{2}$	$2^{11}/_{16}$	$2^{13}/_{16}$
Length of Nail, Small or City Head, in inches	$2^{1}/_{4}$	$2^{7}/_{16}$	$2^{5}/_{8}$	$2^{7}/_{8}$
Number in a Pound, Country Head	113	91	73	66
Number in a Pound, City Head	127	99	81	69

HORSE SHOE NAILS—Continued.

STANDARD.

Standard Sizes and Weights per Pound.

No. of Nail	3	4	$4\frac{1}{2}$	5	6	7
Length of Nail, Regular or Country Head, in inches.	...	...	...	2	$2^3/_{16}$	$2^3/_8$
Length of Nail, Small or City Head, in inches	$1^{13}/_{32}$	$1^5/_8$	$1^7/_8$	$1^{15}/_{16}$	$2^1/_8$	$2^5/_{16}$
No. in a Pound, Regular Head	...	264	...	167	137	105
No. in a Pound, City Head	421	294	220	184	145	116

No. of Nail	8	9	10	11	12
Length of Nail, Regular or Country Head, in inches	$2^9/_{16}$	$2^3/_4$	$2^7/_8$	$3^1/_{16}$	$3^1/_4$
Length of Nail, Small or City Head, in inches	$2^1/_2$	$2^{11}/_{16}$	$2^3/_4$	3	...
No. in a Pound, Regular Head	88	71	63	53	49
No. in a Pound, City Head	91	77	68	63	57

PUTNAM.

No. of Nail	1	2	3	4	5	6	7	8	9	10
Length of Nail, in.	$1^1/_{16}$	$1^5/_{16}$	$1^1/_2$	$1^5/_8$	$1^7/_8$	$2^1/_{16}$	$2^1/_4$	$2^1/_2$	$2^{11}/_{16}$	$2^7/_8$
No. in a Pound	675	500	350	265	200	150	120	95	80	70

CHAMPLAIN.

No. of Nail	2	3	4	$4^1/_2$	5	6
Length of Nail, Regular or Country Head, in inches.	...	...	...	...	$1^{15}/_{16}$	$2^1/_8$
Length of Nail, Small or City Head, in inches	$1^1/_4$	$1^3/_8$	$1^5/_8$	$1^{13}/_{16}$	$1^7/_8$	$2^1/_{16}$
No. in a Pound, Regular or Country Head	...	...	...	...	169	144

No. of Nail	7	8	9	10	11	12
Length of Nail, Regular or Country Head, in inches.	$2^5/_{16}$	$2^7/_{16}$	$2^5/_8$	$2^{15}/_{16}$	3	$3^1/_8$
Length of Nail, Small or City Head, in inches	$2^1/_4$	$2^3/_8$	$2^9/_{16}$	$2^3/_4$	$2^{15}/_{16}$	$3^1/_{16}$
No. in a Pound, Regular or Country Head	115	102	78	67	...	...

HORSE SHOE NAILS—Continued.

AUSABLE.

Standard Sizes and Weights per Pound.

No. of Nail.............	2	3	4	$4^1/_2$	5	6
Length of Nail, inches.	$1^3/_{16}$	$1^3/_8$	$1^5/_8$	$1^3/_4$	2	$2^1/_8$

No. of Nail.............	7	8	9	10	11
Length of Nail, inches.	$2^1/_4$	$2^3/_8$	$2^9/_{16}$	$2^3/_4$	$2^{13}/_{16}$

COUNTERSUNK HEADS.

No. of Nail........	2	3	4	$4^1/_2$	5	6	7
No. in a Pound....	466	341	267	223	162	145	109

STANDARD HEADS.

No. of Nail.......	5	6	7	8	9	10
No. in a Pound...	151	132	100	88	72	63

LIGHT HEADS.

No. of Nail........	5	6	7	8	9	10
No. in a Pound...	172	142	113	99	76	68

GOODENOUGH HEADS.

No. of Nail......................	7	8	9
No. in a Pound..................	80	66	59

PLATE HEADS.

No. of Nail......................	2	3	4	$4^1/_2$
No. in a Pound..................	529	385	291	236

Clinton and American count the same as Ausable. Standard and Light Heads made only in cheaper grades.

THE TERM "PENNY" AS APPLIED TO NAILS.

The origin of the term "six-penny," "ten-penny," etc., as applied to nails, though not commonly known, is involved in no mystery whatever. Nails have been made a certain number of pounds to the thousand for many years, and are still reckoned in that way in England, a ten-penny being a thousand nails to ten pounds, a six-penny a thousand to six pounds, a twenty-penny weighing twenty pounds to the thousand; and, in ordering, buyers call for the three-pound, six pound or ten pound variety, etc., until, by the Englishmen's abbreviation of "pun" for "pound," the abbreviation has been made to stand for penny, instead of pound, as originally intended.

LENGTH, WIDTH AND THICKNESS OF TOE CALKS.

All makes are put up in 25-pound boxes of one size only.

PERKINS.

Blunt, Medium Pattern, and Blunt, Long Pattern.

No. of Calk		0	1	2	3	4	5	6	7
Length of Medium Blunt Calk	inch	$1\frac{5}{8}$	$1\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3
Width of Medium Blunt Calk	"	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	1	1
Thickness of Medium Blunt Calk on top	"	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{19}$	$\frac{5}{8}$	$\frac{5}{8}$
Length of Long Blunt Calk	"	$1\frac{7}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{15}{16}$	$3\frac{1}{8}$	..
Width of Long Blunt Calk	"	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	..
Thickness of Long Blunt Calk on Top	"	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	..

Sharp, Medium Pattern, and Sharp, Long Pattern.

No. of Calk		0	1	2	3	4	5	6
Length of Medium Sharp Calk	inches,	..	$1\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$
Width of Medium Sharp Calk	"	..	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{13}{16}$	$\frac{15}{16}$	$1\frac{1}{16}$
Thickness of Medium Sharp Calk on top	"	..	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$
Length of Long Sharp Calk	"	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{15}{16}$	$3\frac{1}{8}$
Width of Long Sharp Calk	"	$\frac{9}{16}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{15}{16}$	$1\frac{1}{16}$
Thickness of Long Sharp Calk on top	"	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{15}{16}$

LENGTH, WIDTH AND THICKNESS OF TOE CALKS—Continued.

STANDARD.

Blunt, Medium Pattern, and Blunt, Long Pattern.

No of Calk	0	1	2	3	4	5	6	7
Length of Medium Blunt Calk........inches,	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3
Width of Medium Blunt Calk.......... "	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{8}$
Thickness of Medium Blunt Calk on top "	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Length of Long Blunt Calk............ "	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$
Width of Long Blunt Calk............. "	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{8}$
Thickness of Long Blunt Calk on top.. "	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$

Country Medium and Long Pattern and Sharp Pattern.

No. of Calk	0	1	2	3	4	5	6	7
Length of Medium Country Pattern Calk..ins.,	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3
Width of Medium Country Pattern Calk.. "	$\frac{15}{32}$	$\frac{31}{64}$	$\frac{5}{8}$	$\frac{47}{64}$	$\frac{27}{32}$	$\frac{7}{8}$	$\frac{15}{16}$	$\frac{15}{16}$
Th'kn's of Med. C'ntry Pat'n Calk on top "	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{11}{32}$	$\frac{13}{32}$	$\frac{29}{64}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{1}{2}$
Length of Long Country Pattern Calk... "	$1\frac{3}{4}$	$1\frac{3}{4}$	2	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$	3	$3\frac{1}{4}$
Width of Long Country Pattern Calk.... "	$\frac{15}{32}$	$\frac{31}{64}$	$\frac{5}{8}$	$\frac{47}{64}$	$\frac{27}{32}$	$\frac{7}{8}$	$\frac{15}{16}$	$\frac{15}{16}$
Th'kn's of Long C'ntry Pat'n Calk on top "	$\frac{9}{32}$	$\frac{21}{64}$	$\frac{11}{32}$	$\frac{13}{32}$	$\frac{29}{64}$	$\frac{15}{32}$	$\frac{1}{2}$	$\frac{1}{2}$
Length of Sharp Pattern Calk........... "	$1\frac{5}{8}$	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{5}{8}$	$2\frac{7}{8}$	$3\frac{1}{8}$	..
Width of Sharp Pattern Calk............ "	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{21}{32}$	$\frac{11}{16}$	$\frac{13}{16}$	$\frac{29}{32}$	1	..
Thickness of Sharp Pattern Calk on top. "	$\frac{11}{32}$	$\frac{25}{64}$	$\frac{13}{32}$	$\frac{29}{64}$	$\frac{33}{64}$	$\frac{19}{32}$	$\frac{21}{32}$	..

LENGTH, WIDTH AND THICKNESS OF TOE CALKS—Continued.

DEWICK.

Blunt, Medium and Long Pattern and Sharp, Medium and Long Pattern—One Prong.

No. of Calk		0	1	2	3	4	5	6	7	8
Length of Medium Blunt Calk	inches,	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	..
Width of Medium Blunt Calk	"	7/16	1/2	9/16	5/8	3/4	13/16	7/8	7/8	..
Thickness of Medium Blunt Calk on top	"	3/8	3/8	7/16	1/2	1/2	9/16	9/16	9/16	..
Length of Long Blunt Calk	"	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2
Width of Long Blunt Calk	"	7/16	1/2	9/16	5/8	3/4	13/16	7/8	7/8	7/8
Thickness of Long Blunt Calk on top	"	5/32	3/8	7/16	1/2	1/2	9/16	9/16	9/16	9/16
Length of Medium Sharp Calk	"	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	..	..
Width of Medium Sharp Calk	"	1/2	5/8	3/4	7/8	1	1	1	..	..
Thickness of Medium Sharp Calk on top	"	3/8	7/16	1/2	9/16	5/8	5/8	11/16	..	..
Length of Long Sharp Calk	"	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	..
Width of Long Sharp Calk	"	1/2	5/8	3/4	7/8	1	1	1 1/8	1 1/8	..
Thickness of Long Sharp Calk on top	"	3/8	7/16	1/2	9/16	5/8	5/8	11/16	11/16	..

Blunt and Sharp—Two Prong.

No. of Calk		0	1	2	3	4	5	6	7
Length of Blunt Calk	inches,	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3
Width of Blunt Calk	"	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8
Thickness of Blunt Calk on top	"	3/8	3/8	7/16	1/2	1/2	9/16	9/16	9/16
Length of Sharp Calk	"	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	..
Width of Sharp Calk	"	1/2	5/8	3/4	7/8	1	1	1 1/8	..
Thickness of Sharp Calk on top	"	3/8	7/16	1/2	9/16	5/8	5/8	5/8	..

LENGTH, WIDTH AND THICKNESS OF TOE CALKS—Continued.

GAUTIER.

City Pattern.

ONE-PRONG, BLUNT.

Size.	Dimensions.
No. 0	$1\frac{1}{4} \times \frac{7}{16} \times \frac{3}{8}$
" 1	$1\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$
" 2	$1\frac{3}{4} \times \frac{9}{16} \times \frac{7}{16}$
" 3	$2 \times \frac{5}{8} \times \frac{1}{2}$
" 4	$2\frac{1}{4} \times \frac{3}{4} \times \frac{1}{2}$
" 5	$2\frac{1}{2} \times \frac{13}{16} \times \frac{9}{16}$
" 6	$2\frac{3}{4} \times \frac{7}{8} \times \frac{9}{16}$
" 7	$3 \times \frac{15}{16} \times \frac{19}{32}$

Country Pattern.

ONE-PRONG, MEDIUM BLUNT.

Size.	Dimensions.
No. 0	$1\frac{1}{4} \times \frac{15}{32} \times \frac{9}{32}$
" 1	$1\frac{7}{16} \times \frac{17}{32} \times \frac{5}{16}$
" 2	$1\frac{11}{16} \times \frac{5}{8} \times \frac{11}{32}$
" 3	$1\frac{7}{8} \times \frac{3}{4} \times \frac{13}{32}$
" 4	$2\frac{1}{8} \times \frac{13}{16} \times \frac{7}{16}$
" 5	$2\frac{1}{2} \times \frac{15}{16} \times \frac{1}{2}$
" 6	$2\frac{3}{4} \times \frac{15}{16} \times \frac{1}{2}$
" 7	$3 \times \frac{15}{16} \times \frac{1}{2}$

Special City Pattern—Long.

ONE-PRONG, BLUNT.

Size.	Dimensions.
No. 0	$1\frac{5}{8} \times \frac{3}{8} \times \frac{5}{16}$
" 1	$1\frac{3}{4} \times \frac{1}{2} \times \frac{11}{32}$
" 2	$1\frac{7}{8} \times \frac{9}{16} \times \frac{3}{8}$
" 3	$2\frac{1}{8} \times \frac{5}{8} \times \frac{13}{32}$
" 4	$2\frac{3}{8} \times \frac{11}{16} \times \frac{7}{16}$
" 5	$2\frac{9}{16} \times \frac{3}{4} \times \frac{1}{2}$
" 6	$2\frac{13}{16} \times \frac{7}{8} \times \frac{9}{16}$
" 7	$3\frac{1}{16} \times \frac{7}{8} \times \frac{9}{16}$

Sharp Pattern.

ONE-PRONG.

Size.	Dimensions.
No. 0	$1\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$
" 1	$1\frac{3}{4} \times \frac{5}{8} \times \frac{7}{16}$
" 2	$2 \times \frac{3}{4} \times \frac{1}{2}$
" 3	$2\frac{1}{4} \times \frac{7}{8} \times \frac{9}{16}$
" 4	$2\frac{1}{2} \times 1 \times \frac{5}{8}$
" 5	$2\frac{3}{4} \times 1 \times \frac{5}{8}$
" 6	$3 \times 1 \times \frac{5}{8}$
" 7	$3\frac{1}{4} \times 1 \times \frac{5}{8}$

LENGTH AND WIDTH OF RUBBER HORSE SHOE PADS.

THE HOLDFAST.

Diamond for ¾ Shoe.

	FRONT.										HIND.					
Nos........	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$
Length, in.	$4\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	$5\frac{7}{8}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	7	$7\frac{1}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$
Width "	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{2}$	$6\frac{3}{4}$	$4\frac{1}{2}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$

American for Full Shoe.

	FRONT.									HIND.					
Nos	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$
Length, in. ...	$4\frac{1}{2}$	$4\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$
Width " ...	4	$4\frac{1}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{1}{2}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$4\frac{1}{4}$	$4\frac{3}{4}$	5	$5\frac{1}{4}$	$5\frac{1}{2}$	$5\frac{3}{4}$

THE NEVERSLIP—Rubber and Cork.

	Length, Inches.	Width, Inches.	Width at Heel, Inside the Shoe. A.	B.	C.	Thickness of Frog. Also of Shoe. Y.	Z.
No. 1........................	5	$4\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{7}{8}$	$2\frac{1}{4}$	$\frac{1}{2}$	$\frac{9}{16}$
No. 2........................	$5\frac{1}{2}$	$4\frac{3}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{16}$
No. 3........................	6	$5\frac{1}{8}$	$1\frac{3}{4}$	$2\frac{1}{4}$	$2\frac{3}{4}$	$\frac{17}{32}$	$\frac{5}{8}$
No. 4........................	$6\frac{1}{4}$	$5\frac{1}{2}$	$1\frac{3}{4}$	$2\frac{3}{8}$	3	$\frac{17}{32}$	$\frac{5}{8}$
No. 5........................	$6\frac{3}{4}$	6	2	$2\frac{5}{8}$	$3\frac{1}{4}$	$\frac{19}{32}$	$\frac{11}{16}$
No. 6........................	$7\frac{1}{8}$	$6\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{7}{8}$	$3\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$

ANVILS.

Approximate Dimensions of Smith's Anvils.

Pounds.	Face, Length and Width.	Square Hole.	Round Hole.
80	12 x3⅛ in.	¾ in.	⅜ in.
100	13 x3½ "	⅞ "	½ "
140	14½x4 "	⅞ "	½ "
175	16¼x4½ "	1 "	½ "
200	16½x4⅝ "	1 "	⅝ "
250	18 x4¾ "	1¼ "	⅝ "
300	20 x5 "	1¼ "	⅝ "
350	21 x5¼ "	1¼ "	⅝ "
400	23 x5½ "	1⅜ "	⅝ "
440	24 x5¾ "	1⅜ "	⅝ "

All Anvils 240 pounds and over have countersunk square hole.

SOLID BOX VISES.

Number indicates as nearly as possible the weight of the Vise in pounds.

Number.	Width of Jaw.	Number.	Width of Jaw.
25	3⅜ in.	105	6 in.
30	3½ in.	110	6 and 6¼ in.
35	3¾ and 3⅞ in.	115	6 and 6¼ in.
40	4 in.	120	6½ in.
45	4¼ in.	125	6½ in.
50	4¼ and 4½ in.	130	6½ and 6¾ in.
55	4½ and 4¾ in.	135	6½ and 6¾ in.
60	4½ to 5 in.	140	7 in.
65	4¾ and 5 in.	145	7 in.
70	5 and 5¼ in.	150	7 in.
75	5 and 5¼ in.	160	7¼ in.
80	5¼ and 5½ in.	170	7¼ in.
85	5¼ and 5½ in.	180	7½ and 8 in.
90	5½ and 5¾ in.	190	7¾ and 8 in.
95	5¾ in.	200	8 in.
100	6 in.		

VISE BOXES AND SCREWS.

Number.	Diam. of Screw.			
1	1⅛ in.	for Vises from No.	30 to No.	50
2	1¼ in.	" " "	55 "	70
3	1¼ in.	" " "	75 "	85
4	1½ in.	" " "	90 "	100
5	1½ in.	" " "	105 "	125
6	1¾ in.	" " "	130 "	195
7	2 in.	" " "	200 "	250

STANDARD SIZES OF CIRCULAR SAW MANDRELS.

Number.	Diameter of Pulley, Inches.	Face of Pulley, Inches.	Diameter of Flange, Inches.	Length of Shaft, Inches.	Diameter of Shaft, Inches.	Size of Hole in Saw, Inches.
1	$2^1/_2$	$3^1/_2$	$2^1/_2$	14	$1\ ^1/_{16}$	1
2	3	4	3	16	$1\ ^3/_{16}$	$1^1/_8$
3	$3^1/_2$	$4^1/_2$	$3^1/_2$	18	$1\ ^5/_{16}$	$1^1/_4$
4	4	5	4	20	$1\ ^7/_{16}$	$1^5/_{16}$
5	$4^1/_2$	$5^1/_2$	$4^1/_2$	22	$1\ ^7/_{16}$	$1^5/_{16}$
6	5	6	5	24	$1\ ^7/_{16}$	$1^3/_8$
7	$5^1/_2$	$6^1/_2$	$5^1/_2$	26	$1\ ^7/_{16}$	$1^3/_8$
8	6	7	6	28	$1\ ^9/_{16}$	$1^1/_2$
9	7	8	6	32	$1^{11}/_{16}$	$1^5/_8$
10	8	8	6	36	$1^{13}/_{16}$	$1^5/_8$

STANDARD LENGTH, IN INCHES, OF CUT AND WEIGHT, WITH HANDLE, OF HATCHETS AND BENCH AXES.

Nos	1	2	3
Shingling	$3\frac{1}{2}$	$3\frac{7}{8}$	$4\frac{3}{8}$
Weight, lbs	$1\frac{1}{2}$	2	2 lbs. 9 oz.
Claw	$3\frac{1}{2}$	4	$4\frac{3}{8}$
Weight, lbs	$1\frac{3}{4}$	2	2 lbs. 5 oz.
Half	$3\frac{1}{4}$	$3\frac{5}{8}$	4
Lath	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{3}{4}$
Weight	1 lb. 4 oz.	1 lb. 6 oz.	1 lb. 9 oz.

BROAD HATCHETS.

Nos	1	2	3	4	5	6	7
Width of Cut, in inches	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6	$6\frac{1}{2}$	7
Weight, with handle, lbs.	2	$2\frac{1}{2}$	3	$3\frac{1}{4}$	$3\frac{1}{2}$	4	$4\frac{1}{2}$

MOLASSES GATES.

No.	1	2	3	4	5
Inside Diameter	13-16	$\frac{7}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$
Bore	1	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{5}{8}$	$1^{13}/_{16}$

THE SIZES OF SKATES

COMPARE WITH SIZES OF SHOES AS FOLLOWS.

Skates, in.	7	$7\frac{1}{2}$	8	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$
Shoes, No.	$9\frac{1}{2}$	11	$12\frac{1}{2}$	1	$2\frac{1}{2}$	4	$5\frac{1}{2}$	$7\frac{1}{2}$	9	$10\frac{1}{2}$

PLATE AND BEDSTEAD CASTERS.

SIZE, IN INCHES OF WHEELS OF EACH.

Plate.........No.	1	2	3	4	5	6	7
Size	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1^7/_{16}$	$1\frac{1}{2}$
Bedstead, Old No.	$1\frac{5}{8}$.0	$1\frac{5}{8}$.1	$1\frac{5}{8}$.2	2 in 0	2 in 1	2 in 2	2 in he'vy
New "	101	102	103	104	105	106	107
Size	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	2	$2\frac{1}{4}$

ESTIMATED SHIPPING WEIGHTS.

All of the weights given below are for good Forest Growth and Dry Stock Unseasoned will weigh from 10 to 25 per cent more. An additional 10 or 15 per cent should be added for choicest grade of Timber, more especially in Spokes, Rims, Shafts, Poles, Singletrees and Neckyokes.

OAK SPOKES.

Size, in.	2	2⅛	2¼	2⅜	2½	2⅝	2¾	3	3¼	3½	3¾	4
Lbs. pr set	55	60	70	75	80	90	95	110	120	130	145	175

HICKORY SPOKES.

Size, in.	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
Lbs. pr set	20	25	28	32	36	40	46	48	54	60

OAK HUBS.

Diameter, in.	6	6½	7	7½	8	8¼	8½	9	9½	10	10½	11	12
Lbs. pr set	20	25	30	35	40	45	50	60	75	85	95	110	125

ELM HUBS.

Diameter, in.	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6	6½	7	7½	8
Lbs. pr set	4	4½	5	5½	7	8	9	10	11	12	13	14	15	18	25	30	37

SAWED WAGON FELLOES.

Size, in.	1¾x2¼	2x2½	2x2⅝	2x2¾	2x3	2¼x3	2½x3
Lbs. pr set	75	85	90	95	115	130	160

BENT FELLOES.

Size, in.	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	1¾x2	1¾x2¼
Lbs. pr set	21	25	30	35	45	50	55	65	75	80	75	85

Size, in.	2x2	2x2¼	2x2½	2½x2	2¾x2	3x2	3½x2	4x2	5x2	6x2
Lbs. pr set	85	95	100	100	110	120	140	160	200	240

BENT SHAFTS.

Size, in.	1⅜x2	1½x2	1½x2¼	1¾x2¼	2x2½	2x2¾	3x3
Lbs. pr doz. pairs	135	150	170	180	220	240	265

BENT POLES.

Size, in.	1¾x2¼	2x2½	2x2¾	2x3	2¼x3
Lbs. pr dozen	155	180	200	220	245

HICKORY AXLES.

Size, in.	2½x3½	3x4	3½x4½	4x5	4x6	4½x5½	5x6	6x7
Lbs. pr set	37	48	64	80	96	97	120	200

BOLSTERS AND SANDBOARDS.

4 FEET LONG.

Size, in.	3x4	3½x4½	3½x5	4x5	4½x5½	5x6
Lbs. each	16	21	23	27	33	40

REACHES.

Size	2x4x8 ft.	2x4x10 ft.	2x4x12 ft.	2½x4½x8 ft.	2½x4½x10 ft.	2½x4½x12 ft.
Lbs. each	22	27	32	31	40	48

WAGON TONGUES.

Size, in.	3	3½	4	4½	4x5	5x5
Lbs. each	28	36	48	54	60	75

BRAKE BARS.

Size, in.	2x5	2½x5	2½x6	3x6	3x7	3x8
Lbs. each	20	26	30	36	42	48

WAGON GEARING.

11 Pieces .... 55 lbs. pr set.

BENT HAWNS.

2x3 .... 20 lbs. each.

SINGLETREES.

	BUGGY,	EXPRESS,	OVAL WAGON,	ROUND WAGON,	IRONED WAGON.
Lbs. pr dozen	22	26	35	40	70

NECKYOKES.

	BUGGY,	EXPRESS,	WAGON,	IRONED WAGON.
Lbs. pr dozen	25	30	45	90

EVENERS.

	BUGGY,	EXPRESS,	LIGHT,	HEAVY,
Lbs. pr dozen	60	75	120	135

ESTIMATED SHIPPING WEIGHTS.

BOWS.

	SHORT BUGGY.	LONG BUGGY.	EXPRESS.	WAGON.
Lbs. pr set	15	20	25	30

PLOW HANDLES.

Size, in.	$1\frac{1}{4}$x$2\frac{1}{4}$	$1\frac{3}{8}$x$2\frac{1}{2}$
Lbs. pr dozen	51	54

PLOW BEAMS.

	TWO-HORSE.	THREE-HORSE
Lbs. each	24	27

BOB RUNNERS.

Size, in.	2x$2\frac{1}{2}$	2x$2\frac{3}{4}$	2x3	2x$3\frac{1}{2}$	2x4	2x$4\frac{1}{2}$	2x5	$2\frac{1}{2}$x5
Lbs. pr set	35	40	45	60	65	75	115	145

BOB GEARING.

	BEAMS.	KNEES.	RAVES.	ROLLERS.	SADDLE.	REACH.	BENCHES
Lbs. pr set	60	40	60	25	10	$7\frac{1}{2}$	120

CUTTER STUFF.

	1-SEAT SQ.	2-SEAT SQ.	1-SEAT PORT.	2-SEAT PORT.	1-SEAT SWELL.	2-SEAT SWELL.
Lbs. pr set	30	35	35	40	35	40

CUTTER WOODS.

	1-SEAT SQ.	2-SEAT SQ.	1-SEAT PORT.	2-SEAT PORT.	1-SEAT SWELL.	2-SEAT SWELL.
Lbs. each	65	90	75	125	75	150

BODIES.

	PIANO.	PLATFORM.	JUMP-SEAT.	IMPROVED IRONED.
Lbs. each	50	115	100	135

	PHAETON.	EXTENSION TOP.	SURREY.
Lbs. each	85	200	85

SEATS.

	SQUARE CORNER.	ROUND CORNER.	EXCELSIOR.	GRAHAM'S.
Lbs. each	11	11	10	12

GEARS.

	ONE-SEAT, NO BODY.	ONE-SEAT, WITH BODY.	TWO-SEAT, NO BODY.	TWO-SEAT, WITH BODY.	PHAETON, WITH BODY.	HANSON & MACK'S.
Lbs. each	110	190	125	225	270	175

PLATFORM GEARINGS.

Capacity	1,000 lbs.	1,500 lbs.	2,000 lbs.	2,500 lbs.	3,000 lbs.
Lbs. each	45	50	55	60	70

SULKY GEARINGS.

Lbs. pr set, Light..........18 Medium..........23

WHEELS.

Tread, in.	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$
Lbs. pr set	44	58	65	85	93	115	135

HANDLES.

	AXE.	RAILROAD PICK.	COAL PICK.	DRIFTING PICK.	SLEDGE.	HAMMER.
Lbs. pr doz.	20	30	20	20	15	7

ROUGH BUGGY GEARING.

	AXLE BEDS.	SPRING BARS.	REACHES.	HEAD BLOCKS.	SIDE BARS.
Lbs. pr doz	65	38	55	28	65

POLE CIRCLES.

Inch	$1\frac{1}{4}$	$1\frac{3}{8}$	$1\frac{1}{2}$
Lbs. pr doz	28	35	44

SHAFT BARS.

Inch	$1\frac{1}{2}$x2	2x$2\frac{1}{2}$
Lbs. pr dozen	62	85

LUMBER.

Oak	4,250 lbs. pr 1,000 feet.
Ash	4,000 " " " "
Hickory	4,250 " " " "
Whitewood	3,500 " " " "
Basswood	3.500 " " " "

TABLE OF EMERY WHEEL SPEEDS.

The following table designates number of revolutions per minute for specified diameters of wheels, to cause them to run at the respective periphery rates of 4,000, 5,000 and 6,000 feet per minute.

The medium of 5,000 feet is usually employed in ordinary work, but in special cases it is sometimes desirable to run them at a lower or higher rate according to requirements.

The stress on the wheel at 4,000 feet periphery speed per minute, is 48 pounds per square inch. At 5,000 feet, 75 pounds. At 6,000 feet, 108 pounds.

Diameter Wheel in Inches.	Rev. per Minute for Surface Speed of 4,000 feet.	Rev. per Minute for Surface Speed of 5,000 feet.	Rev. per Minute for Surface Speed of 6,000 feet.
1	15,279	19,099	22,918
2	7,639	9,549	11,459
3	5,093	6,366	7,639
4	3,820	4,775	5,730
5	3,056	3,820	4,584
6	2,546	3,183	3,820
7	2,183	2,728	3,274
8	1,910	2,387	2,865
10	1,528	1,910	2,292
12	1,273	1,592	1,910
14	1,091	1,364	1,637
16	955	1,194	1,432
18	849	1,061	1,273
20	764	955	1,146
22	694	868	1,042
24	637	796	955
30	509	637	764
36	424	531	637

HOW TO ERECT MACHINE TOOLS.

When Machine Tools are first received, if they have been shipped any distance in an open or box car, a large amount of dirt and grit will accumulate in transit. In order to thoroughly remove these, the tools should be taken carefully apart and thoroughly cleaned.

The next thing to be considered is the foundation, and if on the ground floor, would in all cases recommend, when possible, that the tools be placed on a stone foundation ; the advantages obtained by so doing will well repay the extra cost. Careful leveling of the machine after it has been placed in position is imperative. Be sure your level is accurate and sensitive, and in addition to this you will need a true straight edge; with these the machine can be tested until known to be correct.

The countershaft should also be level, and in strict alignment with the main line.

One of the most important things in starting a new machine, and the one which is most often neglected, is to see that the machine is well lubricated, and with a good quality of oil; the very best oil is the cheapest, and should be used in generous quantities, particularly for the first few weeks the machine is running. Convenient places are provided for oiling all bearings, and careful attention should be given to see that all bearings and sliding surfaces are well lubricated.

If these directions are carefully followed there will be little trouble about the machine running properly.

DIRECTIONS FOR HARDENING LATHE CENTERS.

The point of center should be heated to a bright red, then cooled in clean, cold water. After it becomes cold, it should be withdrawn and the dirt cleaned at once from same, that color may be seen. Our centers should be drawn to a light straw color, on account of the special grade of steel used. Care should be taken not to heat center very far back, as it is liable to become sprung' should such be done.

COMPARATIVE TABLE OF THE UNITED STATES AND METRIC SYSTEMS.

DENOMINATION.	EQUIVALENT.
One grain equals in grammes	0.0648
One pound avoirdupois equals in kilogrammes	0.4536
One tonne of 2240 pounds equals in tonnes	1.0160
One tonne of 2000 pounds equals in tonnes	0.9071
One inch equals in millimetres	25.400
One foot equals in metres	0.3048
One mile equals in kilometres	1.6094
One square inch equals in square millimetres	645.2
One square foot equals in square metres	0.09291
One acre equals in ares (100 square metres)	40.47
One square mile equals in square kilometres	2.500
One cubic inch equals in cubic centimetres	16.30
One cubic foot equals in cubic metres	0.02832
One cubic yard equals in cubic metres	0.7646
One quart dry measure equals in litres	1.101
One quart liquid or wine measure equals in litres	0.9465
One foot pound equals in kilogrammetres	0.1383
One pound per foot equals in kilogrammes per metre	1.488
One thousand pounds per square inch equals in kilogrammes per square millimetre	0.503
One pound per square foot equals in kilogrammes per square metre,	4.882
One pound per cubic foot equals in kilogrammes per cubic metre.	16.02
One degree Fahrenheit equals in degrees centigrade	0.5556

COMPARATIVE TABLE OF THE METRIC SYSTEM AND UNITED STATES WEIGHTS AND MEASURES.

DENOMINATION.	EQUIVALENT.
One gramme equals in grains	15 433
One kilogramme equals in pounds avoirdupois	2.2047
One tonne equals in tons of 2240 pounds	0.9843
One tonne equals in tons of 2000 pounds	1.1024
One millimetre equals in inches	0.03937
One metre equals in feet	3.2807
One kilometre equals in miles	0.6213
One square millimetre equals in square inches	0.00155
One square metre equals in square feet	10.763
One are (100 square metres) equals in acres	0.02471
One square kilometre equals in square miles	0.3861
One cubic centimetre equals in cubic inches	0.0610
One cubic metre or stere equals in cubic feet	35.3105
One cubic metre equals in cubic yards	1.3078
One litre (one cubic decimetre) equals in cubic inches	60.017
One litre equals in quarts, dry measure	0.908
One litre equals in quarts, liquid or wine measure	1.0566
One kilogrammetre equals in foot pounds	7.2331
One kilogramme per metre equals in pounds per foot	0.6720
One kilogramme per square millimetre equals in pounds per square inch	1422.
One kilogramme per square metre equals in pounds per square foot,	0.2084
One kilogramme per cubic metre equals in pounds per cubic foot	0.0624
One degree centigrade equals in degrees Fahrenheit	1.8

A CONVENIENT METRIC CONVERSION.

The following metric conversion table was compiled by Mr. C. W Hunt, of New York City:

Millimeters × .03937 = inches.
Millimeters ÷ 25.4 = inches.
Centimeters × .3937 = inches.
Centimeters ÷ 2.54 = inches.
Meters = 39.37 inches. (Act of Congress.)
Meters × 3.281 = feet.
Meters × 1.094 = yards.
Kilometers × .621 = miles.
Kilomcters × 3280.7 = feet.
Square Millimeters × .0155 = square inches.
Square Millimeters ÷ 645.1 = square inches.
Square Centimeters × .155 = square inches.
Square Centimeters ÷ 6.451 = square inches
Square Meters × 10.764 = square feet.
Square Kilometers × 247.1 = acres.
Hectares × 2.471 = acres.
Cubic Centimeters ÷ 16.383 = cubic inches.
Cubic Meters × 35.315 = cubic feet.
Cubic Meters × 1.308 = cubic yards.
Cubic Meters × 264.2 = gallons (231 cubic inches).
Liters × 61.022 = cubic inches. (Act of Congress.
Liters × .2612 = gallons (231 cubic inches)
Liters ÷ 3.78 = gallons (231 cubic inches).
Liters ÷ 28.316 = cubic feet.
Grammes × 15.432 = grains. (Act of Congress.)
Grammes (water) ÷ 29.57 = fluid ounces.
Grammes ÷ 28.35 = ounces avoirdupois.
Grammes per cubic cent. ÷ 27.7 = pounds per cubic inch.
Joule × .7373 = foot pounds.
Kilograms × 2.2046 = pounds.
Kilograms × 35.3 = ounces avoirdupois.
Kilograms ÷ 1102.3 = tons (2,000 pounds).
Kilograms per square cent. × 14.223 = pounds per square inch.
Kilo-watts × 1.34 = horse power.
Watts ÷ 746 = horse power.
Calorie × 3.968 = B. T. U.
Cheval vapeur × .9863 = horse power.
(Centigrade × 1.8) + 32 = degrees Fahrenheit.
Francs × .193 = dollars.

Table of Decimal Equivalents of Millimeters and Fractions of Millimeters.

$\frac{1}{100}$ mm. = .0003937″

Mm.	Inches.	Mm.	Inches.	Mm.	Inches.
$\frac{1}{50}$	=.00079	$\frac{27}{50}$	= .02126	4	= .15748
$\frac{2}{50}$	=.00157	$\frac{28}{50}$	= .02205	5	= .19685
$\frac{3}{50}$	=.00236	$\frac{29}{50}$	= .02283	6	= .23622
$\frac{4}{50}$	=.00315	$\frac{30}{50}$	= .02362	7	= .27559
$\frac{5}{50}$	=.00394	$\frac{31}{50}$	= .02441	8	= .31496
$\frac{6}{50}$	=.00472	$\frac{32}{50}$	= .02520	9	= .35433
$\frac{7}{50}$	=.00551	$\frac{33}{50}$	= .02598	10	= .39370
$\frac{8}{50}$	=.00630	$\frac{34}{50}$	= .02677	11	= .43307
$\frac{9}{50}$	=.00709	$\frac{35}{50}$	= .02756	12	= .47244
$\frac{10}{50}$	=.00787	$\frac{36}{50}$	= .02835	13	= .51181
$\frac{11}{50}$	=.00866	$\frac{37}{50}$	= .02913	14	= .55118
$\frac{12}{50}$	=.00945	$\frac{38}{50}$	= .02992	15	= .59055
$\frac{13}{50}$	=.01024	$\frac{39}{50}$	= .03071	16	= .62992
$\frac{14}{50}$	=.01102	$\frac{40}{50}$	= .03150	17	= .66929
$\frac{15}{50}$	=.01181	$\frac{41}{50}$	= .03228	18	= .70866
$\frac{16}{50}$	=.01260	$\frac{42}{50}$	= .03307	19	= .74803
$\frac{17}{50}$	=.01339	$\frac{43}{50}$	= .03386	20	= .78740
$\frac{18}{50}$	=.01417	$\frac{44}{50}$	= .03465	21	= .82677
$\frac{19}{50}$	=.01496	$\frac{45}{50}$	= .03543	22	= .86614
$\frac{20}{50}$	=.01575	$\frac{46}{50}$	= .03622	23	= .90551
$\frac{21}{50}$	=.01654	$\frac{47}{50}$	= .03701	24	= .94488
$\frac{22}{50}$	=.01732	$\frac{48}{50}$	= .03780	25	= .98425
$\frac{23}{50}$	=.01811	$\frac{49}{50}$	= .03858	26	=1.02362
$\frac{24}{50}$	=.01890	1	= .03937		
$\frac{25}{50}$	=.01969	2	= .07874		
$\frac{26}{50}$	=.02047	3	= .11811		

10 Mm. = 1 Centimeter = 0.3937 Inches.
10 Cm. = 1 Decimeter = 3.937 "
10 Dm. = 1 Meter = 39.37 Inches.
25.4 Mm. = 1 English Inch.

NOTES ON THE WORKING OF STEEL.

1. Good soft heat is safe to use if steel be immediately and thoroughly worked. It is a fact that good steel will endure more pounding than any iron.

2 If steel be left long in the fire it will lose its steely nature and grain, and partake of the nature of cast iron. Steel should never be kept hot any longer than is necessary for the work to be done.

3. Steel is entirely mercurial under the action of heat, and a careful study of the tables will show that there must of necessity be an injurious internal strain created whenever two or more parts of the same piece are subjected to different temperatures.

4. It follows that when steel has been subjected to heat not absolutely uniform over the whole mass, careful annealing should be resorted to.

5. As the change of volume due to a degree of heat increases directly and rapidly with the quantity of carbon present; therefore, high steel is more liable to dangerous internal strains than low steel, and great care should be exercised in the use of high steel.

6. Hot steel should always be put in a perfectly dry place of even temperature while cooling. A wet place in the floor might be sufficient to cause serious injury.

7. Never let anyone fool you with the statement that his steel possesses a peculiar property which enables it to be "restored" after being "burned"; no more should you waste any money on nostrums for restoring burned steel. We have shown how to restore "overheated" steel. For "burned" steel, which is oxidized steel, there is only one way of restoration, and that is through the knobbling fire or blast furnace "Overheating" and "restoring" should only be allowable for purposes of experiment. The process is one of disintegration, and is always injurious.

8. Be careful not to overdo the annealing process; if carried too far it does great harm, and it is one of the commonest modes of destruction which the steel maker meets in his daily troubles. It is hard to induce the average worker in steel to believe that very little annealing is necessary, and that a very little is really more efficacious than a great deal.

Mr. Kirkaldy's experiments show conclusively:

1. That the breaking strain of iron and steel does not (as hitherto assumed) indicate the quality. A high-breaking strain *may* be due to hard, unyielding character, or a low one may be due to extreme softness. The contraction of *area at the fracture* forms an essential element in estimating the quality.

2. Iron when fractured suddenly produces a crystalline fracture; but if gradually, a fibrous fracture. This accounts for the anomaly in the supposed change of iron from a fibrous to a crystalline character. Sudden shoulders which prevent a regular elongation of fibre cause a sudden snap.

3. Strength of steel is reduced by being hardened in water; but both its hardness and toughness are increased by being hardened in oil. Iron heated and suddenly cooled in water is hardened, and the breaking strain (if gradually applied) is increased, but it is more likely to snap suddenly. It is softened and its breaking strain reduced if heated and allowed to cool gradually. Iron if brought to a white heat is injured if it be not at the same time hammered or rolled. Case-hardening bolts weakens them.

STEEL.

Steel is a compound of iron and carbon, varying in proportion of 0.5 per cent. to 5 per cent. of carbon. Specific gravity 7.8; tensile strength, 120,000 lbs. per square inch. Ordinary steel is carbon steel, but steely compounds of iron have been produced which have the same general properties as ordinary steel, the carbon of which is replaced by other chemical elements.

TO TEST STEEL AND IRON.

Nitric acid will produce a black spot on steel: the darker the spot, the harder the steel. Iron, on the contrary, remains bright if touched with nitric acid. Good steel in its soft state has a curved fracture and a uniform gray lustre; in its hard state a dull, silvery, uniform white. Cracks, threads or sparkling particles denote bad quality.

Good steel will not bear a white heat without falling to pieces, and will crumble under the hammer at a *bright* red heat, while at a middling heat it may be drawn out under the hammer to a fine point.

TEMPERING STEEL.

Color.	Purpose.	Tem. Fah.	Alloy whose fusing point is same temperature	
			Tin.	Lead.
Light straw	Turning tools for metal	430°	1 to	1¾
Dark straw	Wood tools, taps and dies	470°	1 to	2½
Brown yellow	Hatchets, chipping chisels	500°	1 to	4¾
Dark purple	Springs, etc	550°	1 to	12

CASE HARDENING.

Place horn, hoof, bonedust or shreds of leather, together with the article to be casehardened, in an iron box subject to a blood-red heat, then immerse the article in cold water.

CASE HARDENING WITH PRUSSIATE OF POTASH.

Heat the article after polishing to a bright red, rub the surface over with prussiate of potash; allow it to cool to dull red, and immerse it in water.

CASE-HARDENING MIXTURES.

3 prussiate of potash.
1 sal-ammoniac.
or,
1 prussiate of potash.
2 sal-ammoniac.
bone-dust.

THE SIZING AND CUTTING OF GEAR WHEELS.

The word "diameter" when applied to gears, is always understood to mean the pitch diameter.

DIAMETRAL PITCH of the gear is the number of teeth to each inch of its pitch diameter.

If a gear has 40 teeth and the pitch diameter is 4 inches, there are 10 teeth to each inch of the pitch diameter, and the diametral pitch is 10, or in other words, the gear is 10 diametral pitch.

CIRCULAR PITCH is the distance from the center of one tooth to the center of the next tooth, measured along the pitch circle.

If the distance from the center of one tooth to the center of next tooth. measured along the pitch circle, is 1-2″, the gear is 1-2″ circular pitch.

THE DIAMETRAL PITCH given, to obtain the circular pitch divide 3 1416 by the diametral pitch.

If the diametral pitch is 4, divide 3.1416 by 4, and the quotient, .7854″, is the circular pitch.

THE CIRCULAR PITCH given, to obtain the diametral pitch, divide 3.1416 by the circular pitch.

If the circular pitch is 2″, divide 3.1416 by 2 and the quotient, 1.5708, is the diametral pitch.

THE NUMBER OF TEETH AND THE DIAMETRAL PITCH given, to obtain he pitch diameter, divide the number of teeth by the diametral pitch.

If the number of teeth is 40 and the diametral pitch is 4, divide 40 by 4, and the quotient, 10, is the pitch diameter.

THE NUMBER OF TEETH AND THE DIAMETRAL PITCH given, to obtain the whole diameter of size of blank of gear, add 2 to the number of teeth and divide by the diametral pitch.

If the number of teeth is 40, and the diametral pitch is 4, add 2 to the 40, making 42, and divide by 4; the quotient, 10 1-2, is the whole diameter of the gear or blank.

THE NUMBER OF TEETH AND THE DIAMETER OF THE BLANK given, to

obtain the diametral pitch, add 2 to the number of teeth, and divide by the diameter of the blank.

If the number of teeth is 40, the diameter of the blank is 10 1-2″, add 2 to the number of teeth, making 42, and divide by 10 1-2: the quotient, 4, is the diametral pitch.

THE PITCH DIAMETER AND THE DIAMETRAL PITCH given, to obtain the number of teeth, multiply the pitch diameter by the diametral pitch.

If the diameter of the pitch circle is 10″, and the diametral pitch is 4, multiply 10 by 4, and the product, 40, will be the number of teeth in the gear.

THE WHOLE DIAMETER OF THE BLANK AND THE DIAMETRAL PITCH given, to obtain the number of teeth in the gear, multiply the diameter by the diametral pitch and subtract 2.

If the whole diameter is 10 1-2, and the diametral pitch is 4, multiply 10 1-2 by 4, and the product, 42 less 2, or 40 is the number of teeth.

THE THICKNESS OF A TOOTH AT THE PITCH LINE is found by dividing the circular pitch by 2, or divide 1.57 by the diametral pitch.

If the circular pitch is 1.047″, or the diametral pitch is 3, divide 1.047 by 2, or 1.57 by 3, and the quotient, .523 inch, is the thickness of tooth.

THE WHOLE DEPTH OF A TOOTH is found by dividing 2.157 by the diametral pitch.

If the diametral pitch of a gear is 6, the whole depth is 2.157 divided by 6, equals .3595.

THE WHOLE DEPTH of a tooth is about 11-16, or exactly .6866 of the circular pitch.

If the circular pitch is 2, the whole depth of tooth is about 11-16 of 2 inches, or 1 3-8 inches nearly.

THE DISTANCE BETWEEN THE CENTERS OF TWO GEARS is found by adding the number of teeth together, and dividing half the sum by the diametral pitch.

If two gears have 50 and 30 teeth, respectively, and are 5 pitch, add 50 and 30, making 80, divide by 2, and then divide the quotient, 40, by the diametral pitch, 5, and the result, 8″, is the center distance.

No. 1 will cut wheels from 135 teeth to a rack.

" 2	"	"	55	"	"	134 teeth.
" 3	"	"	35	"	"	54 "
" 4	"	"	26	"	"	34 "
" 5	"	"	21	"	"	25 "
" 6	"	"	17	"	"	20 "
" 7	"	"	14	"	"	16 "
" 8	"	"	12	"	"	13 "

If a cutter is wanted for a wheel of 40 teeth of 8 pitch, then the cutter required, would be No. 3 of 8 pitch, inasmuch as a No. 3 cutter will cut all wheels containing from 35 to 54 teeth, inclusive, and 40 occurring between those numbers, that is the one desired. It should be borne in mind that eight different cutters are required in order to cut all the wheels of any given pitch.

As these cutters allow of being ground when dull, it is important that they be KEPT SHARP. By paying particular attention to this the cutting will be greatly facilitated beside being much better done.

It is desirable in applying gearing of any kind, to avoid having wheels or pinions with a small number of teeth. Pinions of twelve teeth will work very well, but a less number of teeth should not be used.

Few mechanics are familiar with the minutiae of gearing and the necessity of exact sizing of wheels, as to diameter, is often overlooked. Special care is required also to know that the distance of the centres of two wheels running together is correct relatively to the diameters.

TABLE SHOWING DEPTH OF SPACE AND THICKNESS OF TOOTH IN SPUR WHEELS, WHEN CUT WITH PATENT CUTTERS.

Pitch of Cutter	Depth to be Cut in Gear. Inch.	Thickness of Tooth at Pitch Line. Inch.	Pitch of Cutter.	Depth to be Cut in Gear. Inch.	Thickness of Tooth at Pitch Line. Inch.
2	1.078	.785	12	180	.131
2¼	.958	697	14	.154	.112
2½	.863	.628	16	135	.098
2¾	.784	.570	18	120	.087
3	.719	.523	20	.108	.079
3½	616	.448	22	.098	.071
4	.539	.393	24	.090	.065
5	.431	.314	26	.083	060
6	.359	.262	28	.077	.056
7	.308	.224	30	.072	.052
8	.270	196	32	.067	.049
9	.240	.175	36	.060	.044
10	.216	157	40	.054	.039
11	.196	.143	48	.045	.033

FORMULAS

FOR DETERMINING THE DIMENSIONS OF GEARS BY DIAMETRAL PITCH.

Let	P	denote the	*diametral pitch* or the number of teeth to one inch of diameter of pitch circle.		
"	D	" "	diameter of pitch circle.	*Larger Wheel.*	These wheels run together
"	D	" "	whole diameters.		
"	N	" "	number of teeth.		
"	V	" "	velocity.		
"	d′	" "	diameter of pitch circle.	*Smaller Wheel.*	
"	d	" "	whole diameter.		
"	n	" "	number of teeth		
"	v	" "	velocity.		
"	a	" "	distance between the centers of the two wheels.		
"	b	" "	number of teeth in both wheels.		
"	t	" "	thickness of tooth or cutter on pitch circle.		
"	D″	" "	working depth of tooth		
"	f	" "	amount added to depth of tooth for rounding the corners and for clearance.		
"	D″+f	" "	whole depth of tooth.		
"	π		constant 3.1416.		
"	P′		circular pitch, or the distance from the centre of one tooth to the centre of the next on the pitch circle.		

The examples placed opposite the formulas on the two pages following are for a *single* wheel of 12 pitch, 6.166 in., or 6 2-12 in. diameter, etc. and in the case of the *two* wheels the larger has the *same* dimensions. The velocities are respectively one and two.

FORMULAS. EXAMPLES.

$P = \frac{N+2}{D} = \frac{72+2}{6.166}$, or $\frac{72+2}{6\ 2\text{-}12}$ 12. 1.

$P = \frac{N}{D'} = \frac{72}{6} = 12.$ 2.

$D' = \frac{D \times N}{N+2} = \frac{6.166 \times 72}{72+2} = 6.$ 3.

$D' = \frac{N}{P} - \frac{72}{12} = 6.$ 4.

$N = P\ D' = 12 \times 6 = 72.$ 5.

$N = P\ D - 2 = 12 \times 6.166 - 2$, or $12 \times 6\ 2\text{-}12 - 2 = 72.$ 6.

$D = \frac{N+2}{P} = \frac{72+2}{12} = 6.166$, or $6\ 2\text{-}12.$ 7.

$D = D' + \frac{2}{P} = 6 + \frac{2}{12}$, or $6 + .166 = 6.166.$ 8.

$t = \frac{1.57}{P} = \frac{1.57}{12} = .130.$ 9.

$D'' = \frac{2}{P} = \frac{2}{12} = .166$, or 2-12. 10.

$f = \frac{t}{10} = \frac{.130}{10} = .013.$ 11.

$D'' + f = .166 + .013 = .179.$ 12.

$P' = \frac{\pi}{P} = \frac{3.1416}{12} = 262.$ 13.

$P = \frac{\pi}{P'} = \frac{3.1416}{.262} =$ 14.

FORMULAS. EXAMPLES.

$b = 2\,a\,P = 2 \times 4.5 \times 12 = 108.$ 15.

$n = \dfrac{b\,V}{v + V} = \dfrac{108 \times 1}{3} = 36.$ 16.

$N = \dfrac{n\,v}{V} = \dfrac{36 \times 2}{1} = 72.$ 17.

$n = \dfrac{N\,V}{v} = \dfrac{72 \times 1}{2} = 36.$ 18.

$N = \dfrac{b\,v}{v + V} = \dfrac{108 \times 2}{3} = 72.$ 19.

$n = \dfrac{P\,D'\,V}{v} = \dfrac{12 \times 6 \times 1}{2} = 36.$ 20.

$V = \dfrac{n\,v}{N} = \dfrac{36 \times 2}{72} = 1.$ 21.

$v = \dfrac{N\,V}{n} = \dfrac{72 \times 1}{36} = 2.$ 22.

$v = \dfrac{P\,D'\,V}{n} = \dfrac{12 \times 6 \times 1}{36} = 2.$ 23.

$D = \dfrac{2a\,(N + 2)}{b} = \dfrac{2 \times 4.5 \times (72 + 2)}{108} = 6.166.$ 24.

$d = \dfrac{2a\,(n + 2)}{b} = \dfrac{2 \times 4.5 \times (36 + 2)}{108} = 3.166.$ 25.

$a = \dfrac{b}{2\,P} = \dfrac{108}{2 \times 12} = 4.5.$ 26.

$D' = \dfrac{2\,a\,v}{v + V} = \dfrac{2 \times 4.5 \times 2}{3} = 6.$ 27.

$d' = \dfrac{2\,a\,V}{v + V} = \dfrac{2 \times 4.5 \times 1}{3} = 3.$ 28.

$a = \dfrac{D' + d'}{2} = \dfrac{6 + 3}{2} = 4.5.$ 29.

CALCULATING SPEED OF PULLEYS.

TO FIND SIZE OF PULLEY ON LINE SHAFT.

Multiply diameter of pulley on countershaft by its number of revolutions and divide the product by number of revolutions of line shaft. The quotient will be the diameter of pulley on line shaft.

EXAMPLE.—Countershaft runs 120 revolutions; diameter of pulley, 10 inches; line shaft runs 120. $120 \times 10 = 1200$. $\frac{1200}{120} = 10$ inches diameter.

TO FIND SIZE OF PULLEY ON COUNTERSHAFT.

Multiply diameter of pulley on line shaft by its number of revolutions, and divide the product by number of revolutions of countershaft.

EXAMPLE.—Diameter of pulley on line shaft, 18 inches; line shaft runs 160 revolutions; countershaft runs 120 revolutions.

$$\frac{18 \times 160}{120} = 24 \text{ inches diameter.}$$

TO FIND NUMBER OF REVOLUTIONS OF COUNTERSHAFT.

Multiply diameter of pulley on line shaft by its number of revolutions, and divide product by diameter of pulley on countershaft.

EXAMPLE.—Diameter of pulley on line shaft, 30 inches; line shaft runs 140 revolutions; diameter of pulley on countershaft. 12. $\frac{30 \times 140}{12} =$ 350 revolutions.

RULE FOR GEARING ENGINE LATHES FOR SCREW CUTTING.

Take from the index the number of threads cut by equal gears and multiply it by a number that will give for a product a gear on the index. Place this gear on the spindle or stud. Then multiply the number of threads per inch to be cut by the same number, and put the resulting gear on the screw.

EXAMPLE.—Lathe cuts four threads by equal gears, and thirteen threads per inch are wanted.

$$\frac{\text{Spindle or stud}}{\text{Threads to be cut}} = \frac{4}{13}$$

The constant five will give for a product a gear on the index $\frac{4 \times 5 = 20.}{13 \times 5 = 65.}$

Therefore, to cut thirteen threads per inch, would require a gear of twenty teeth on the spindle or stud, and a gear of sixty-five teeth on the lead screw.

Diametral pitch is the number of teeth to one inch of diameter of pitch line or circle.

Circular pitch is the distance from center to center of two adjacent teeth on the pitch line.

No. 1 table shows the diametral pitches with the corresponding circular pitches.

No. 2 table shows the circular pitches with the corresponding diametra pitches.

TABLE No. 1.				TABLE No. 2.			
Diam'l Pitch.	Circular Pitch.	Diam'l Pitch	Circular Pitch.	Circular Pitch.	Diamet'l Pitch.	Circu'r Pitch.	Diamet'l Pitch.
2	1.571 in.	12	.262 in.	2	1.571 in.	7/8	3.590 in
2¼	1.396 "	14	.224 "	1⅞	1.676 "	13-16	3.867 "
2½	1.257 "	16	.196 "	1¾	1.795 "	¾	4.189 "
2¾	1.142 "	18	.175 "	1⅝	1.933 "	11-16	4 570 "
3	1 047 "	20	.157 "	1½	2.094 "	⅝	5.027 "
3½	.898 "	22	.143 "	1 7-16	2 185 "	9-16	5.585 "
4	.785 "	24	.131 "	1⅜	2.285 "	½	6 283 "
5	.628 "	26	.121 "	1 5-16	2.394 "	7-16	7.181 "
6	.524 "	28	.112 "	1¼	2.513 "	⅜	8.378 "
7	.449 "	30	.105 "	1 3-16	2.646 "	5-16	10.053 "
8	.393 "	32	.098 "	1⅛	2.793 "	¼	12.566 "
9	.349 "	36	.087 "	1 1-16	2.957 "	3-16	16.755 "
10	.314 "	40	.079 "	1	3.142 "	⅛	25.133 "
11	.286 "	48	.065 "	15-16	3.351 "	1-16	50.266 "

According to the system adopted by the Brown & Sharpe Mfg. Co., any wheel of one pitch will gear into any other wheel or into a rack of the same pitch. Eight cutters are required for each pitch. These eight cutters are adapted to cut from a pinion of twelve teeth to a rack, and are numbered respectively, 1, 2, 3, etc. The number of teeth and the pitch for which a cutter is adapted is also marked on each.

Material Required for Tops.

FULL LEATHER BUGGY TOP.

Top Leather	60 ft.
Body Cloth	1½ yds.
Head Lining	4 "
Buckram	1½ "
Enam. Drill	½ "
Tanback & Moleskin	1 "
Curled Hair	10 lbs.
Knobs	1½ doz.
Knob Eyelets	2½ "
Double Buckle Loops	⅓ "
Rubber Prop Block	8 in.
Prop Block Washers	⅓ doz.
Curtain Light	1 only.
Bow Sockets	1 set.
Props	1 "
Prop Nuts	⅔ doz.
Prop Rivets	⅓ "
Stump Joints	⅓ "
Shifting Rail	1 set.
Short Bows	1 "

Tacks, Cord, Lining Nails, Buttons or Tufts sufficient.

Full Rubber Top, same material as above, except in place of leather, 2½ yards of Rubber for roof, side-quarters and back stays, and 3 yards colored-back rubber for curtains. For Apron 2 yards white-back rubber.

PHAETON TOP.

Body Cloth	2 yds.
Head Lining only	1½ "
Head & Curtain Lin'g	4 "
Rubber Roof, Quarters and Stays	2½ "
Rubber, Curtains only	3 "

PHAETON CANOPY TOP.

Body Cloth	1½ yds.
Head Lining	1½ "
Head and Curtain Lining	5½ "
Rubber Roof and Curtains	6¾ "
Rubber for Curtains only	4½ "
Fringe, where no hood is used	4 "
Fringe, where hood is used	2½ "

EXTENSION TOP.

Body Cloth	4 yds.
Head Linng, only	3 "
Head & Curtain Lin'g	5 "
Rubber Roof, Quarters and Stays	5½ "
Rubber for Curtains	6 "
For Full Leather Top	2 hides.

SURREY CANOPY TOP.

Body Cloth	3¼ yds.
Head Lining, only	2½ "
Head and Curtain Lining	8½ "
Rubber Roof	2½ "
Rubber for Curtains only	7 "
Fringe, where no hood is used	7 "
Fringe, where hood is used	6 "

WIRE BALE TIES.

Nos. 16, 15, 14, 13 and 12 are put in bundles of 250 Ties. Nos. 11, 10 and 9 wire are put up in bundles of 125 Ties, and run in length from 6 feet to 11¼ feet.

To get length of Tie required, add three inches to the measure around the bale when under pressure.

SIZE AND LENGTH OF TIES IN GENERAL USE.

For 17x22 Perpetual Presses, use Ties 8, 8½ or 9 feet long; No. 14 wire for heavy work, and No. 15 for light work.

For 14x18 Perpetual Presses, use Ties 8, 8¼ or 8½ feet long; No. 14 wire for extra or extreme heavy work; No. 15 for heavy and medium work, and No. 16 for light work.

For 12x15 Perpetual Presses, use Ties 7½, 7¾ or 8 feet long; No. 15 wire for heavy work, and No. 16 for medium or light work.

For Upright Hand Presses use No. 14 or No. 15 wire.

For Upright Light Horse Presses, use No. 14 wire.

For Upright Heavy Portable or Light Stationary Horse Presses, use No. 13 wire.

For Upright Heavy Stationary and Beater Presses, use No. 12, No. 11 and No. 10 wire, according to the size of the bale and number of Ties used.

For Broom Corn, Wool, Cotton, Hides, etc., or other materials put up in heavy bales, use No. 9, No. 10 or No. 11 wire.

STRENGTH OF ICE.

Ice 2 inches thick will bear men on foot.
Ice 4 inches thick will bear men on horseback.
Ice 6 inches thick will bear logging teams with light loads.
Ice 8 inches thick will bear logging teams with heavy loads.
Ice 10 inches thick will bear 1,000 lbs. to the square foot.
This table is for pure sound ice.

NUMBER OF FEET IN A LOG.

To ascertain the number of feet (board measure) in a log of a given size, deduct four inches from its diameter at small end, square the remainder, multiply the product by the length of log and divide by 16, the result will be the board measure contents of log.

RAILWAY SIGNAL CODE.

One whistle signifies "down brakes." Two whistles signify "off brakes." Three whistles signify "back up." Continued whistles signify "danger." Rapid short whistles "a cattle alarm." A sweeping parting of the hands on the level with the eyes, signifies "go ahead." Downward motion of the hands with extended arms, signifies "stop." Beckoning motion of one hand, signifies "back." Red flag waved up the track, signifies "danger." Red flag stuck up by the roadside, signifies "danger ahead." Red flag carried on a locomotive, signifies "an engine following." Red flag hoisted at a station, is a signal to "stop." Lantern at night raised and lowered vertically, is a signal "to start." Lantern swung at right angles across the track, means "stop." Lantern swung in a circle, signifies "back the train."

GREATEST KNOWN DEPTH OF THE OCEAN.

The greatest depth which has been ascertained by sounding is five miles and a quarter (25,720 feet, or 4,620 fathoms), not quite equal to the height of the highest known mountain, Mount Everest, which measures 29,002 feet, or 5½ miles high. The average depth between 60 degrees north and 60 degrees south, is nearly three miles.

SOME THINGS THAT ARE MISNAMED.

The misapplication of a name in speaking of the common things of life is a source of many errors, especially in the young. The reason why things are not rightly named in all cases is not because of any deficiency of our language, but because the names of most common substances were given long years ago, and very often before the true nature of the articles were understood. The *Journal of Applied Science* has this to say upon the subject:

Why should trade not have a Johnson to classify and correct the mass of inconsistencies that go to make up its nomenclature? We not only tax our brains to invent "fantastic" names for every new fabric, varied, perhaps, only by a thread or a shade from what our grandparents wore a century ago, but there are in use positive misnomers for many staple articles of merchandise. The following imperfect list, culled from sources already at hand, will give a faint idea of them:

Acid (sour), applied in chemistry to a class of bodies to which sourness is only accidental, and by no means a universal characteristic. Thus rock crystals, quartz, flint, etc., are chemical acids, though no particle of acidity belongs to them.

Black lead does not contain a single particle of lead, being composed of carbon and iron.

Brazilian grass does not come from Brazil, or even grow there; nor is it grass at all. It consists of a palm leaf (Thrinax argentea), and is imported chiefly from Cuba.

Burgundy pitch is not pitch, nor is it manufactured in or exported from Burgundy. The best is a resinous substance prepared from common frankincense, and brought from Hamburg; but by far the greater quantity is a mixture of rosin and palm oil.

China, as a name for porcelain, gives rise to the contradictory expressions—British china, Dutch china, Chelsea china, etc., like wooden milestones, iron milestones, brass shoe-horns, iron pens, steel pens.

Cuttle bone is not bone at all, but a structure of pure chalk, once embedded loosely in the substance of certain species of cuttle fish. It is enclosed in a membraneous sac within the

body of the fish, and drops out when the sac is opened, but it has no connection whatever with the sac of the cuttle fish.

Galvanized iron is not galvanized. It is simply iron coated with zinc; and this is done by dipping it in a zinc bath containing muriatic acid.

German silver is not silver at all, nor was the metallic alloy called by that name invented by a German, but has been in use in China time out of mind.

Honey soap contains no honey, nor is honey in any way employed in its manufacture. It is a mixture of palm oil soap and olive oil soap, each one part, with three parts of curd soap, or yellow soap scented.

Japan lacquer contains no lac at all, but is made from the sap of a tree called Rhus vernicifera.

Kid gloves are not usually made from kid skins, but of lamb or sheep skins. At present many of them are made of rat skins.

Meerschaum is not petrified "sea foam," as its name implies, but is a composition of silica, magnesia and water.

Mosaic gold has no connection with Moses or the metal gold. It is an alloy of copper and zinc, used in the ancient museum or tessellated work.

Mother-of-pearl is the inner layer of several sorts of shells. It is not the mother of pearl, as its name indicates, but in some cases the matrix of the pearl.

Pen means a feather (Latin penna, a wing). A steel pen is not a very choice expression.

Prussia blue does not come from Prussia, but is the precipitate of the salt of protoxide of iron with prussiate of potassa.

Salad oil is not oil for salad, but oil for cleaning sallades—*i. e.*, helmets.

Salt is not salt at all, and has long been excluded from the class of bodies denominated "salts."

Sealing wax is not wax at all, nor does it contain a single particle of wax. It is made of shellac, Venice tupentine and cinnibar. Cinnibar gives it a deep, red color, and the turpentine renders the shellac soft and less brittle.

Sperm oil properly means "seed oil" (Latin, sperma, seed), from the notion that it was spermaceti (the sperm or melt of a whale). The sperm whale is the whale that gives "seed oil," which is taken chiefly but not wholly from the head.

Whalebone is not bone at all, nor does it possess any of the properties of bone. It is a substance attached to the upper jaw of the whale, and serves to strain the water which the creature takes up in large mouthfuls.

Rhinoceros horn is no horn at all, but a kind of matted or compact hair, and is only like a horn from being a protuberance on the animal's head.

TELEGRAPH AND TELEPHONE WIRE.

WEIGHT PER MILE-OHM.—This term is to be understood as distinguishing the *resistance of material* only, and means the weight of such material required per mile to give the resistance of one ohm. To ascertain the mileage resistance of any wire, divide the "weight per mile-ohm" by the weight of the wire per mile. Thus in a grade of Extra Best Best, of which the weight per mile-ohm is 5,000, the mileage resistance of No. 6 (weight per mile 525 lbs.) would be about 9½ ohms; and No. 14 steel wire, 6,500 lbs., weight per mile-ohm (95 lbs. weight per mile), would show about 69 ohms.

The grades of LINE WIRE are generally known to manufacturers, consumers, and the trade in this country, as "Extra Best Best" (E. B. B.), "Best Best" (B. B.), "Best" (B.), and "Steel,"

The "Extra Best Best" is made of the very best iron, as nearly pure as any commercial iron, soft, tough, uniform, and of very high conductivity, its weight per mile-ohm being about 5,000 lbs.

The "Best Best" is of excellent iron, showing in mechanical tests almost as good results as the E. B. B., but not quite as soft, and being somewhat lower in conductivity; weight per mile-ohm about 5,700 lbs.

Some manufacturers have ceased to make the grade known as "Best"—which term has become to some extent a misnomer, as it has been much applied to inferior wire hardly suited for telegraphic purposes, and having a weight per mile-ohm of 6,000 to 7,000 lbs. It is found that wire made from Bessemer or Open-Hearth Steel, low in carbon, gives better satisfaction, being tougher and stronger than iron wire that can be furnished at an equal price per pound, and offering no more resistance to the electric current. This "Steel" wire is well suited for Telephone or short Telegraph Lines, and the weight per mile-ohm is about 6,500 lbs.

The following are (approximately) the weights per mile of various sizes of Galvanized Telegraph Wire, drawn by Trenton Iron Co.'s gauge:

No.	4,	5,	6,	7,	8,	9,	10,	11,	12,	13,	14,
Lbs.	720,	610,	525,	450,	375,	310,	250,	200,	160,	125,	95,

Telegraph Wire is frequently made by Birmingham wire gauge.

SIZES OF WIRE USED IN TELEGRAPH AND TELEPHONE LINES.

No. 4. Has not been much used until recently; is now used on important lines where the multiplex systems are applied.
No. 5. Little used in the United States.
No. 6. Used for important circuits between cities.
No. 8. Medium size for circuits of 400 miles or less.
No. 9. For similar locations to No. 8, but on somewhat shorter circuits; until lately was the size most largely used in this country.
No. 10. } For shorter circuits, railway telegraphs, private lines,
No. 11. } police and fire alarm lines, &c.
No. 12. For telephone lines, police and fire alarm lines, &c.
No. 13. } For telephone lines and short private lines; steel wire
No. 14. } is used most generally in these sizes.

THE COATING OF TELEGRAPH WIRE with zinc as a protection against oxidation is now generally admitted to be the most efficacious method. Some years ago telegraph wire used to be boiled in linseed oil, which process cost less than galvanizing and protected the wire tolerably well, except where it was exposed to the action of sea air. It can still be coated in that manner if required; but a good coat of zinc is the best protection against rust, and wire so coated is moreover a better conductor than plain wire.

JOINTS IN TELEGRAPH WIRE.—The fewer the joints in a line the better; hence the advantage of the present method of making single pieces of wire weighing 90 or 100 lbs. (or even 150 lbs.) instead of (as a few years ago) 30 to 50 lbs. All joints should be carefully made and well soldered over, for a bad joint may cause as much resistance to the electric current as several miles of wire.

MISUSE OF THE REFRIGERATOR.

Among the vast mass of people in this country the uses and possibilities of the Refrigerator are not understood. Most housewives believe that anything that has been kept in the refrigerator is good and wholesome food. This belief exists in spite of the fact that every housekeeper can tell of instances within her own experience where food kept in one of these ice boxes has spoiled, and consequently been thrown away.

Man must take his food before putrefaction has begun. The savage takes it fresh, or else under conditions that admit of little putrefaction.

As men grew civilized, one of the first things they turned their attention to was that of preserving food, or rather of preventing putrefaction. To begin with, they improved the method of drying meat by exposing it to the smoke of a fire in place of

the rays of the sun. Then the effect of salt was discovered, then that of saltpetre, then that of cold in the form of ice, and finally the effect of *cold*, *dry air*, which is the *highest* point reached.

The effect of cold on food is to retard putrefaction, or by freezing, to stop it absolutely. But in Household Refrigerators the food is never frozen. The action of cold in the refrigerators is to delay or retard the process of putrefaction; in other words, to lengthen the period between death and the time when the food becomes uneatable and poisonous in its effects on the consumer.

The misuse of the refrigerator, to quote the title of this article, lies in the belief that the ice box will prevent putrefaction. Just so long as its owner regards it only as a contrivance which will only retard decay she is safe, and her refrigerator will do her good service.

Probably not one housekeeper in a hundred, and not one servant in a thousand, has any idea of what is meant by keeping the refrigerator clean. Properly, all the refrigerators should be washed out thoroughly once a week, with hot water in which soda has been dissolved. But merely to wash out the refrigerator is not enough; it must be cleaned. This means that the corners must be scrubbed out, the waste pipe thoroughly cleansed, and the whole thing made as clean as the proverbial new pin. Then, before the ice is put into it, it should be well aired. The solution of soda should be washed out with fresh hot water. This must all be done at least once a week.

CYRUS EDSON, M. D.

Sanitary Superintendent of the New York Board of Health.

POINTS ON VARNISH.

Drying and Hardening.—Proper light and ventilation are absolutely necessary to facilitate drying and hardening. Varnish applied in buildings that are damp and not properly heated in cold weather, will be considerably retarded in drying and hardening. Extremely hot weather will also keep varnish soft for quite a time. The best results are obtained at a temperature of 70 to 75 degrees Fahrenheit.

Turning White.—It is caused by the action of water and dampness. The more elastic the varnish, the better it will resist this action, whereas, cheap, brittle, quick-drying varnishes are very easily affected.

Brittleness.—Is an inherent defect in the varnish caused by an excess of dryer, lack of oil, or adulterated materials having been used in its manufacture. If a varnish powders white under friction of the finger or easily scratches white, that is incontrovertible evidence of its poor quality. Brittle varnishes

should not be used even for the undercoats, as they destroy the toughness and durability of the finish, despite its being protected with an elastic, durable, finishing varnish. It is poor economy, in any event, to use brittle varnishes, as the cost of application, which is the main expense, is the same as if good material were employed.

CHILLING.—As its name implies, is caused by exposure to cold weather. Varnish should never be used while in this condition. The remedy is to keep the chilled varnish in a warm room, until it has been restored to its normal condition. Long exposure to cold weather may also cause the varnish to become "specky" and "seedy," in which event it is necessary to keep it near a steam pipe or warm stove for some time, until the chilled particles have disappeared.

CRACKING.—Cracking is caused by the undercoats not having been dry when the finishing coat was applied, or when abnormally heavy coats have been used, especially for the undercoats. Brittle varnishes are liable to crack when exposed to sudden changes of temperature.

BLOOMING OR GOING FOGGY.—Is caused by exposure to dampness, moisture or gases, AFTER the varnish has become hard. The more elastic the varnish, the less liable it is to "bloom" or become "foggy."

WRINKLING, CRAWLING, CRAMPING OR SAGGING.—Is caused by applying the varnish too heavily or by exposure to sudden changes of temperature while in the process of drying, or if the undercoats are not dry when the finishing coat is applied.

DEADENING OR SINKING AWAY.—Caused by the undercoats not having been allowed sufficient time to dry, causing the finishing coat to become absorbed while in the course of hardening. Insufficient foundation coats will also cause the finishing to sink away.

BLISTERING.—Is caused by the action of heat, especially from the concentrated rays of the sun, if sap or dampness is retained in the wood, or if moisture exists in the undercoats when the finishing coat is applied.

PITTING.—Is caused by applying varnish over an oily or damp surface; also, if the varnisher is not careful to thoroughly incorporate the turpentine in reducing the varnish, or uses improper thinning material.

KNOTS AND SAPPY WOODS.—The sap and knots should be "killed" by the use of grain or wood alcohol shellac for the first coat. If this is not done, the sap will work through and injure the finish.

THINNING.—When found necessary, should be done with spirits of turpentine. In order to insure proper amalgamation, neither the varnish nor the turpentine should be too cold when

mixing. The warmer the varnish and turpentine, the quicker the amalgamation. After reducing the varnish, allow it to stand awhile before using. Oil, Japan or liquid dryer should NEVER be added to varnish.

SWEATING.—Is caused by rubbing the undercoat before it is thoroughly dry.

PAINT FAILURE.

BLISTERING.—Due to paint being too thick, or second coat being put on before first coat is dry. Sometimes caused by lumber being green or wet at time of painting.

CRACKING.—Caused by wet or green lumber, also adulterated oil or too much thinner or improper treatment of the pigments.

CHALKING.—This is the prevalent complaint. White lead will always chalk on outside work. It is due to chemical action between the lead and oil by which the oil is destroyed and the white powder of the pigment alone remains. Chalking is more rapid in hot climates than in cold, and is also hastened by the use of adulterated oil and an excess of thinners. Zinc paint properly made is said to be entirely free from this objection.

Paint failure is so frequent that it will pay an owner or architect to investigate carefully. The universal use of zinc as a pigment in France, and its growing popularity in this country in the face of great opposition, shows that it has merits worthy of consideration.

COST OF PAINTING.

This is a difficult problem for the architect. We shall not attempt to give accurate rules. For exterior work, two coats on good surface, ordinary colors, from $1.50 to $2.50 per square of 100 square feet; three-coat work, $2.50 to $3.50 per square. This includes material and labor. The labor is from two to four times the cost of the material. One gallon of first quality paint will cover an average of 250 square feet to 350 square feet, two coats.

USEFUL NOTES FOR BUILDERS.

Roof boards weigh about three pounds per superficial foot.

Terra cotta tiling weighs from 25 to 35 pounds per square foot.

Hollow tile for five-inch partition weighs from 22 to 35 pounds per superficial foot.

Lath and plastering, two-coat work, weighs from 9 to 12 pounds per superficial foot.

The weight of a superficial foot of brickwork eight inches thick, including mortar, is from 83 to 87 pounds.

An iron roof 100 feet wide, with a rise of one-third pitch, will weigh from 10 to 15 pounds per superficial foot.

One hundred pounds per square foot distributed uniformly over a surface of a bridge is a safe working standard.

The weight per square foot of roof tiling, set in iron or between wood rafters ready for slating, is about 12 pounds.

A fireproof floor constructed of iron beams and four-inch brick arches will weigh from 65 to 75 pounds per superficial foot.

The safe and proper bearing of joist, timber and girders supporting a floor should not exceed ten tons on brick walls and fourteen tons on good stone walls.

A fireproof floor constructed of iron beams and iron arches made of No. 18 iron, and filled in on top with concrete or slag and cement, will weigh about the same as brickwork four inches thick.

Smallest convenient size of slab for a 14-inch washbowl, 21 by 24 inches. Height of slab from floor, 2 feet 6 inches. Very small (12) inch corner washbowl: slab 1 foot 11 inches each side.

Space occupied by water closets, 2 feet 6 inches wide, 2 feet deep.

Urinals should be not less than 2 feet 2 inches between partitions; partitions 6 feet high.

Horse Stalls.—Width, 3 feet 10 inches to 4 feet, or over 5 feet in width and 9 feet long. Width should not be between 4 and 5 feet, as in such case the horse is liable to cast himself.

Pitch of Tin, Copper or Tar and Gravel Roof.—Five-eighths of an inch to the foot and upward.

A load of mortar measures a cubic yard, requires a cubic yard of sand and nine bushels of lime, and will fill thirty hods.

A bricklayer's hod measuring one foot four inches by nine inches, equals 1,296 cubic inches in capacity, and contains twenty bricks.

A single load of sand or other materials equals a cubic yard.

One thousand bricks closely stacked occupy about fifty-six cubic feet.

One thousand old bricks cleaned and loosely stacked occupy about seventy-two cubic feet.

One hundred yards of plastering will require fourteen hundred laths, four and a half bushels of lime, four-fifths of a load of sand, nine pounds of hair and five pounds of nails, for two-coat work.

A bushel of hair weighs, when dry, about fifteen pounds.

Flashings.—By "flashings" are meant pieces of tin, zinc or copper laid over slate, and up against walls, chimneys, coping, etc.

Counter flashings are of lead or zinc, and are solid between the courses in brick, and turned down over the flashings.

In flashing against stonework, grooves should be cut to receive the counter flashing.

GEOMETRICAL DEFINITIONS.

ANGLE.—An opening between two lines that meet in a point.
RIGHT ANGLE.—A straight line perpendicular to another.
OBTUSE ANGLE.—An angle wider than a right angle.
ACUTE ANGLE.—An angle less than a right angle.
TRIANGLE.—A figure with three sides and three angles.
EQUILATERAL TRIANGLE.—An angle having all sides equal.
ISOSCELES TRIANGLE.—An angle having two of its sides equal.
SCALENE TRIANGLE.—An angle having all its sides unequal.
RIGHT-ANGLED TRIANGLE.—A triangle having one right angle.
OBTUSE-ANGLED TRIANGLE.—A triangle having one obtuse angle.
ACUTE-ANGLED TRIANGLE.—A triangle having all its angles acute.
QUADRANGLE, OR QUADRILATERAL, is a four-sided figure, and may be a
PARALLELOGRAM, having its opposite sides parallel.
SQUARE, having all its sides equal and all right angles.
RECTANGLE, having a right angle.
RHOMBUS, OR LOZENGE, having all its sides equal and no right angles.
RHOMBOID, a parallelogram with no right angles.
TRAPEZIUM, having unequal sides.
TRAPEZOID, having only two sides parallel.
POLYGON, a plane figure having more than four sides.
PENTAGON, having five sides.
HEXAGON, having six sides.
HEPTAGON, having seven sides.
OCTAGON, having eight sides.
NONAGON, having nine sides.
DECAGON, having ten sides.

WHAT MACHINERY ACCOMPLISHES.

1. A sewing machine does the work of 12 women. The United States export 100,000 of these machines yearly.

2. A Boston "bootmaker" will enable a workman to make 300 pairs of boots daily. In 1880 there were 3,100 of these machines in various countries turning out 150,000,000 pairs of boots yearly.

3. Glenn's California reaper will cut, thresh, winnow and put in bags the wheat of 60 acres in 24 hours.

4. The Hercules ditcher, Michigan, removes 750 cubic yards or 700 tons of clay per hour.

5. The Darlington borer enables one man to do the work of seven in making a tunnel, and reduces the cost to one-third of work done by hand; it also permits a week's work to be done in two days.

PIN TUMBLER LOCKS.

This perfected form of lock is the result of the study of mechanics for thousands of years, the first locks having tumblers of this type being used by the Egyptians over two thousand years ago. In the Egyptian locks, however, the tumblers were located at a distance from the face of the escutcheon of the lock and a long and cumbersome key was required to operate the lock.

By successive steps the tumblers have been brought close to the face of the cylinder, permitting the use of a short key, the key way has been made in irregular sections to add to the security of the lock, and in the latest form made by Eagle Lock Co. we have the short key, the key way in a form which closes it to a picking tool and at the same time gives the key a wide bearing surface on the center of the tumbler, insuring the easy insertion and withdrawal of the key as well as the highest degree of security.

STEEL SASH PULLEYS.

The manufacturers of the "Fox-All-Steel" Pulleys claim the following points of excellence:

Double strength with half the weight, reducing freight charges by one-half.

Every part is steel, and therefore practically indestructible.

Each part is made in duplicate steel dies and accurately formed under extreme pressure, resulting in a perfect fit in the mortise.

Neat in appearance, being polished or finished in nickel, copper or "antique" plated finish for extra fine work.

One smooth polished steel surface runs on another. The patent double shouldered steel bushing makes a perfect and durable bearing.

Quickly inserted as it is driven into four holes bored for the purpose—no nails or screws required.

The Shell of the "Fox-All-Steel" Pulley is made with corrugated sides so formed for strength and rigidity, and for convenience in inserting. It is designed to fit exactly in a mortise made by boring four 13-16 in. holes in a line with centers ⅝ in. apart. No Counter Boring or Cutting and Fitting to "let in" a heavy face plate. These four holes may be quickly made with a single 13-16 in. bit.

The Spurs at the four corners of the shell, acting as staples, cut their way into the jamb when the pulley is driven down flush and hold it firmly in place, also preventing any possible splitting of the wood.

The Wheel is composed of two steel discs rigidly formed and firmly fastened together by a Double Shouldered Steel Bushing.

The Wheel Discs are cut from heavy sheet steel formed under extreme pressure.

The Bushing Itself is formed from specially rolled steel and bronze, and used exclusively in Fox Pulleys to take the continual and excessive wear to which a sash pulley is subjected. The shoulders have just the right angle to give a solid bearing for the wheel discs and when the bushing is riveted over on each end it holds the wheel firmly.

The Axle used in No. 3 pulley is cut from round, smooth drawn rod, squared on each end, which gives the shell a solid bearing and it is of such a length that the shell can not pinch or bind the wheel.

A Driving Set, together with a Cast Iron Marker, is placed in every barrel of pulleys free of charge.

Weight of No. 3 and No. 7 Pulleys is about 2 lbs. per dozen. They are packed 100 dozen in a barrel. Shipping weight 220 lbs. No. 9 Pulley, 200 dozen in a barrel. Shipping weight 275 lbs.

COIL CHAINS.

Size, Weight, Number of Links, Proof in Tons.

Size of Iron, inch	3/16	¼	5/16	⅜	7/16	½	9/16	⅝	¾	⅞	1
No. of Links per ft.	15	13	12	11	9	8	7	6	5½	5	5
Av. wgt. per 100 ft., lbs.	45	75	120	150	200	225	320	400	590	790	1000
Proof, in tons	3/10	9/20	¾	2	2½	4	4½	6½	10	13½	18

Modern and Political Fables.

(Just for fun.)

By AUSTIN BIERBOWER.

LUXURY.

OF TWO cats, one thinking to be very fine hunted only humming-birds, and the other hunted only mice. The first had to hunt much longer than the other, because humming-birds were scarce, so that it spent nearly all its life in getting food, while the other had little trouble to get all it wanted. "How unfortunate it is," said the first cat, "that I have formed my liking for what is so hard to get, and is so little when I have it."

FASTIDIOUSNESS.

A FASTIDIOUS ox would not drink standing in the water with his head turned down stream lest he should soil the water with his feet. But once when drinking with his head turned up stream he saw a whole drove of hogs washing in the water above him.

ATTRACTING ATTENTION.

A FLEA, which saw many people trying to get the attention of a King and waiting long for that purpose, said, "Though I am but a little thing, I will get his attention." So he jumped up the throne until he got on the King's head. Here he received recognition from the King by a slap; and when he boasted to a dog of his success the latter said, "Some get attention by their merit, others by their demerit. In making yourself a nuisance you got recognition before the lords of the realm, but only as a flea."

GAMBLING.

A MONKEY playing with a steel trap got his tail cut off. He went back the next day to get his tail, when he got his foot cut off. "Now," he said, "I will go back and get both my foot and my tail." He went back, and the third time he got his head cut off, which ended his monkeying with the trap.

ANNEXATION.

A FOX, going on a hunt, got his tail caught in a trap. Pull as hard as he could he was unable to extricate himself, so he ran off home, dragging the trap with him. On meeting his companions he exclaimed: "See what a capture I have made!"

MUGWUMPERY.

A MULE on one side of a fence was discontented because he was not on the other side. He finally jumped over, when he was equally discontented because he was not back again. "Which side of the fence do you want to be on?" asked a horse. "It does not matter," replied the mule, "provided I am on the other side."

THE NON-PARTISAN.

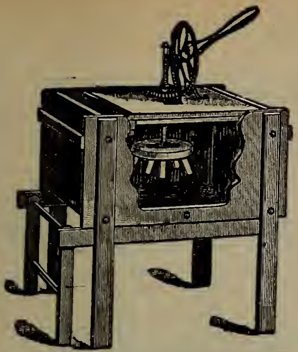
A DOG, running about in an irregular way, was asked where he was going. "I am not going anywhere," replied the dog, "but only running about to learn where to go."

PARTISANSHIP.

THE swans, wishing to drive the peacocks from a park, procured a law against big feet. The peacocks retaliated by getting a counter law against big necks. Soon one side could see nothing but ugly feet, and the other nothing but long necks. At last they came to think peacocks were all feet and swans all neck.

THE

Great Western Washer



Has Galvanized Iron Post with Spring Pressure. Dolly is secured by an extended malleable clamp which prevents it from ever splitting.

FULLY GUARANTEED.

OUR BENBOW ROTARY

Which is furnished either in the round or square is the most powerful and satisfactory Rotary out. Runs forward or backward.

Tub is made of Virginia Cedar, with Galvanized Trimmings. Will last always a lifetime.

The Columbia Washer

Has always been a favorite Washer with the trade. Has iron pin head and post with spring pressure. Made now better than ever before.

Columbia Washer

BENBOW MFG: CO.
13th and Wash Streets,
ST. LOUIS.

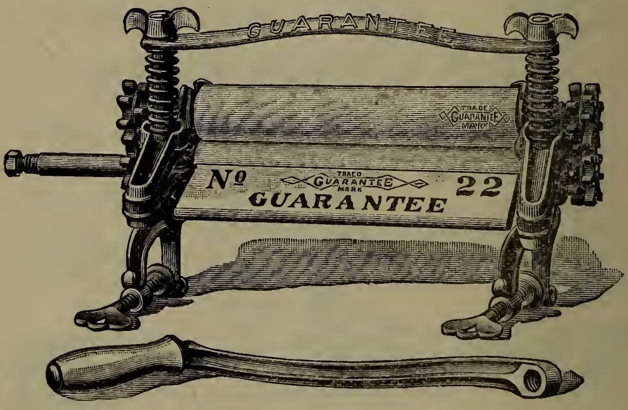
A. F. SHAPLEIGH HARDWARE CO.

WHEN YOU BUY

WRINGERS

BUY THE BEST.

THE GUARANTEE



ARE THE BEST ON EARTH.

ARE WARRANTED FOR 5 YEARS.

—MADE BY—

LOVELL MANUFACTURING CO.,

ERIE, PA.

Sold by A. F. SHAPLEIGH HARDWARE CO.

TRY

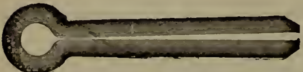
"STANDARD" TOOLS

THEY GIVE SATISFACTION!

TWIST DRILLS, REAMERS, CHUCKS, MILLING CUTTERS.

MANUFACTURED
—BY—

The Standard Tool Co.,
CLEVELAND, OHIO.



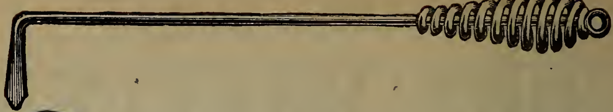
SPRING COTTERS and FLAT KEYS,

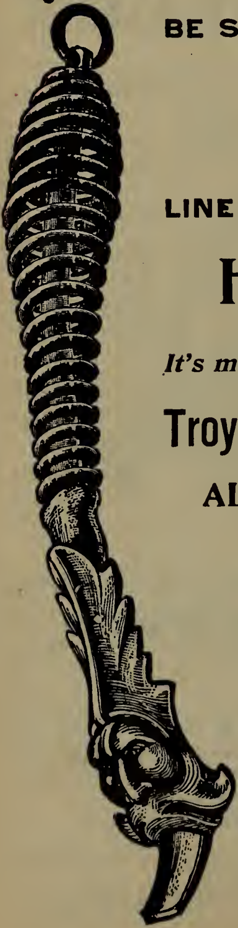
Block furnished with Drills. Sets 5 to 9.

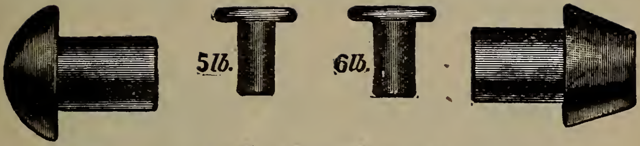
NEW YORK, 94 READE STREET.

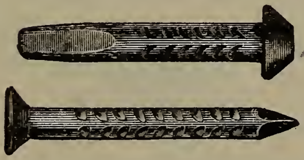
FOREIGN AGENTS: London, Paris, Ronsdorf, Leipzig, St. Petersburg, Yokohama, Malmo, Sweden.

For Sale by A. F. SHAPLEIGH HARDWARE CO.






5lb.
6lb.



"Perfect" Lawn Mower

ALWAYS GIVES ENTIRE SATISFACTION.

REAR CUT, INCASED BEARINGS.

Height of Wheel 9 inches.

The Four Cardinal points of this wheel are SIMPLICITY, DURABILITY, QUALITY AND CHEAPNESS.

HIGH WHEEL

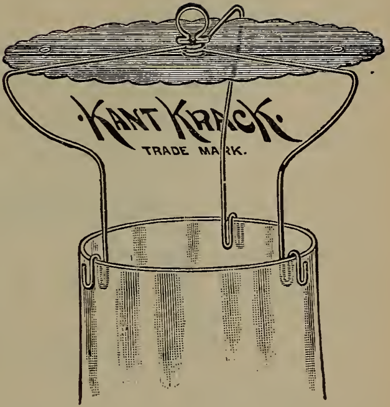
INCASED GEAR.

Inches,	12	14	16	18
Each,	$9.00	9.50	10.00	10.50

We call your special attention to this particular Mower, as it always works nicely and is one of our best sellers. Your customers will be pleased with it.

A. F. Shapleigh Hdw. Co.

ST. LOUIS, MO.



CLEAR AS CRYSTAL,

HIGHEST GRADE,

PRICES RIGHT.

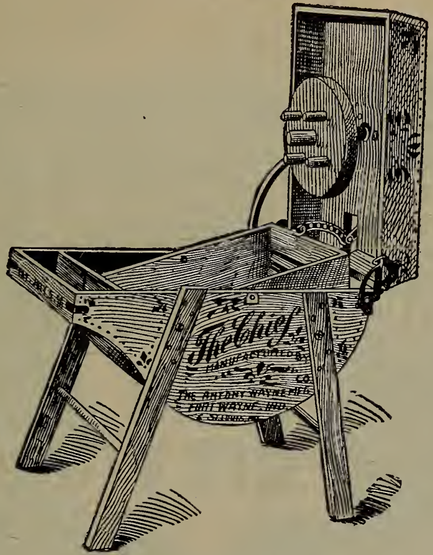
North Carolina Mica Co.

BOSTON CHICAGO

"THE CHIEF!!"

INSIDE VIEW.

The CHIEF Washer is warranted not to bunch the clothes, which all double acting cylinder machines will do. No turning of the clothes necessary.



Buy a CHIEF and do your washing easy and comfortable. The Chief is the only machine that will do this. IT WILL NOT BUNCH THE CLOTHES!!

PATENT ALLOWED.

The Chief Washer is an improvement on the style of Washers made like the St. Louis, the Boss, the Glory and others. We have retained the lower oscillating basket or cylinder in this machine, but have substituted a pin wheel in place of the upper cylinder; by this combination we produce the most effective Washing Machine on the market. All we ask is a trial.

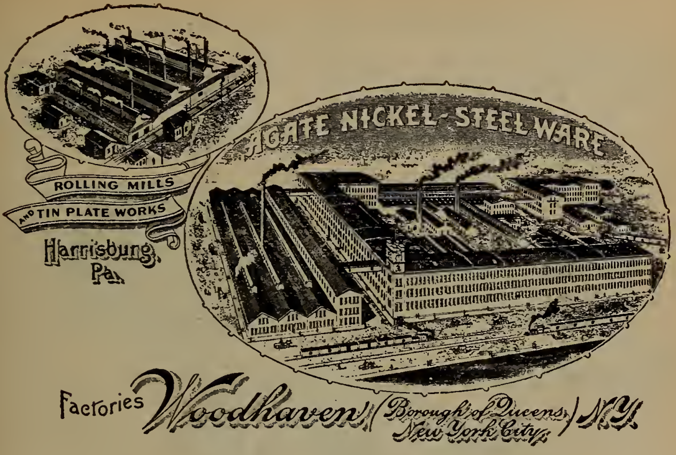
DIRECTIONS FOR OPERATING THE MACHINE.

On the evening before wash day, take one bar of good soap, cut the same into a boiler full of rain water, and heat this until the soap fully dissolves. Take the clothes to be washed, and after having separated them, place the linens and other white goods in a wash tub, pour the hot soap suds over them and cover up the tub until the next morning. In the morning, wring the clothes out of the tub, place them into the machine, so as to fill it about half full (about 15 pieces), pour clean, hot soap suds, prepared as above described, over the clothes so as to cover them well, and then operate the machine from 8 to 10 minutes, then your clothes will be ready to rinse and place on the line to dry.

ANTHONY WAYNE MFG. CO., St. Louis, Mo., and Ft. Wayne, Ind.

For Sale by A. F. SHAPLEIGH HARDWARE CO.

Carried in stock by A. F. SHAPLEIGH HARDWARE CO.



FACTORY OF

LALANCE & GROSJEAN MFG. CO.

NEW YORK.

CHICAGO.

BOSTON.

The largest plant on earth for manufacturing Enameled and Sheet Metal Wares. The home of the "Agate Nickel-Steel," "Pearl Agate," "Peerless" and "Blue and White" Wares, and the celebrated "L. & G." Steel Sinks.

We carry a complete line.

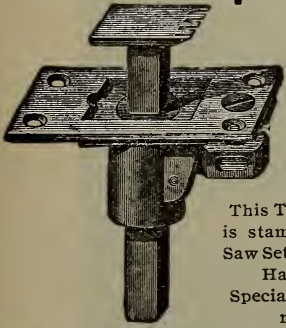
A. F. SHAPLEIGH HARDWARE CO.

CHAS. MORRILL'S
PERFECT SAW SETS, BENCH STOPS,
PUNCHES, Etc.

☛ **THE MASTER PIECE**

No. 95
Saw Set

No. 1
Bench Stop



This Trade Mark is stamped on all Saw Sets and other Hardware Specialties of my make.

TRADE
MARK
Registered, Pat. No. 30,572.

☛ *SEND FOR CATALOGUE.*

CHAS. MORRILL,
BROADWAY AND CHAMBERS, - NEW YORK.

Sold by A. F. SHAPLEIGH HARDWARE CO.

I. X. L.

PATENT GALVANIZED STEEL CHAIN PUMP

Curb and Galvanized Steel Tubing.

IT THROWS MORE WATER AND PUMPS EASIER THAN ANY OTHER PUMP IN EXISTENCE.

IT KEEPS THE WATER PURE AND FRESH.

Patented March 12th, 1895.

In putting this Curb and Tubing on the market, we offer to the public something for which they have long been looking.

Chain Pumps have always been in favor on account of the many advantages they have over others, and the objection to the wood curb and tubing is overcome in the I. X. L. Galvanized Steel Curb and Steel Tubing, making it the best and most beautiful pump on the market.

We especially call attention to its superiority over the old Wooden Suction and Iron Pitcher Pumps, as there are no valves to get out of order or dry out, and it will always throw a larger stream of water than any other Pump on the market

Why You Should Use the I. X. L. Galvanized Steel Tubing.

It does not make the water taste as wood tubing does.
It will not rust, being made out of No. 24 Gauge Best Galvanized Steel.
It will not rot or accumulate filth, and leaves the water clear and pure.
It is anti-freezing, as the reservoir piece has a small hole in same, which allows the water to run out.
It only weighs ½ lb. to the foot, while wood tubing soaked with water weighs 6 lbs. or more per foot.
It can be used in wells as deep as 40 feet.

THE I. X. L. GALVANIZED STEEL TUBING CAN ALSO BE USED ON ANY MAKE OF WOOD CURBS, AS THE STIRRUP ON ALL OTHER CURBS WILL FIT THE SQUARE RESERVOIR BOX ON THE GALVANIZED TUBING.

The I. X. L. Curb is made of the best Galvanized Steel, consisting of only 3 pieces of steel thoroughly locked and seamed together, will not rot, warp or fall to pieces. It is painted and varnished.

THE I. X. L. PUMP AND TUBING IS GUARANTEED TO GIVE PERFECT SATISFACTION.

THE I. X. L. RUBBER BUCKET.

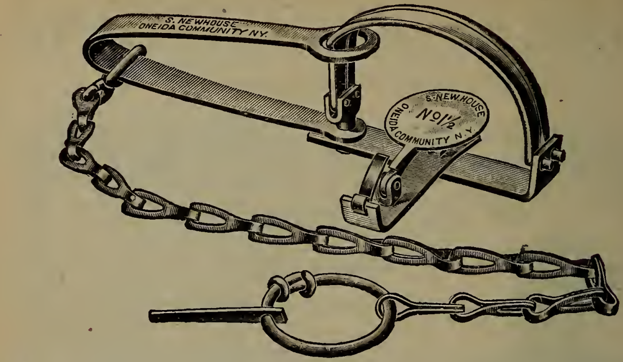
SOME OF ITS POINTS OF SUPERIORITY OVER ALL OTHERS.

1. The only bucket that cannot be put in wrong. This is a special feature over all others, as many buckets are ruined the first time they are used on account of being put in up-side down.
2. It is a double bucket—has two wearing edges instead of one—with a corresponding increase of suction power.
3. It has water space that allows a water packing; which is as good as rubber, without any increase of friction.
4. It is reversible and self-adjusting, as the great pliability of the rubber allows it to adjust itself to any size tubing.
5. A reverse motion of crank will not injure it. The rubber can not be stripped from link.
6. **It gives the best satisfaction in wood tubing, and we especially recommend it for the I. X. L. Galvanized Steel Tubing**

Manufactured by O. P. SCHRIVER & CO., Cincinnati, Ohio.

Write us for Prices. A. F. SHAPLEIGH HARDWARE CO.

NEWHOUSE STEEL TRAPS.



☞ **The Standard for over 50 years. Made in all sizes from Rat Traps to Bear Traps.**

Complete Illustrated Catalogue on application.

ONEIDA COMMUNITY, Ltd., - KENWOOD, N. Y.

Sold by A. F. SHAPLEIGH HARDWARE CO.

AMERICAN AND STEEL WIRE

CHAINS.

PATENTED.

**Halter Chains, Cow Chains,
Dog Chains, Coil Chains,
Key Chains, Trace Chains,
Rein Chains, Sash Chains,
Martingale Chains,
Breast Chains, Dog Couplers,
Dog Collars,
Sheet Steel Swivel,
Harness Snaps,
Solid Steel Harness Snaps.**

ALL KINDS SPECIAL CHAINS.

MANUFACTURED ONLY BY

ONEIDA COMMUNITY, Limited

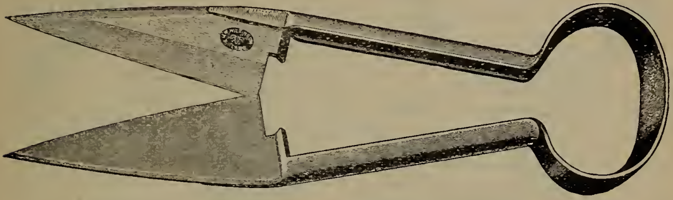
NIAGARA FALLS, N. Y.

For Sale by A. F. SHAPLEIGH HDW. CO.

WILKINSON SHEAR COMPANY,

MANUFACTURERS OF

Sheep, Hedge, Mule and Grass Shears, Etc.



SOLID STEEL, MACHINE FORGED.

No. 3749—Half polished blade, 6 inches, per doz., - -	$7.60
" 3750— " " " swaged, 6 inches, per doz.,	8.00
" 3754—Full " " 6 inches, per dozen, - -	8.55
" 3757E—Full " bows etched, one blade, straight or bent, per dozen, - - - - - - -	11.05
" 3770E—True Vermonter, per dozen, - - - -	15.00

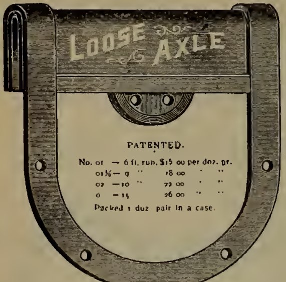
Our friends will find that the **Wilkinson Shear** always gives **ENTIRE SATISFACTION.** We solicit your trade on this line and can fill all orders promptly, as we carry a complete stock.

PRICES ON APPLICATION.

A. F. SHAPLEIGH HARDWARE COMPANY,

SAINT LOUIS.

SOME OF OUR SPECIALTIES.

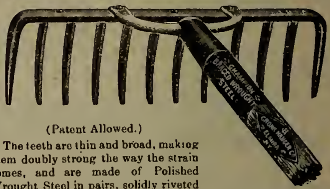


CRONK'S SOLID COVERED LOOSE AXLE BARN DOOR HANGER.

Wheel and Axle Protected from Storm.

Very Strong.

CHAMPION BRACED WROUGHT STEEL
GARDEN RAKE



(Patent Allowed.)

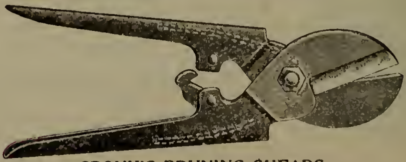
The teeth are thin and broad, making them doubly strong the way the strain comes, and are made of Polished Wrought Steel in pairs, solidly riveted to the Channel Steel Head; the end teeth are crimped which prevents their bending sideways. Strongly braced, has Bronzed Malleable Socket, and is the **STRONGEST AND MOST DURABLE RAKE IN THE MARKET.**

No. 12—12 teeth,	- - - - - - - - - - - -	$12.00
" 14—14 "	- - - - - - - - - - - -	13.00
" 16—16 "	- - - - - - - - - - - -	14.00

CRONK'S SOLID CAST STEEL FLAT NOSE PLYER.

Inch.	4	4½	5
Per Doz.,	$3.00	$3.00	$3.60

CRONK'S FENCE PLYER.



CRONK'S PRUNING SHEARS.

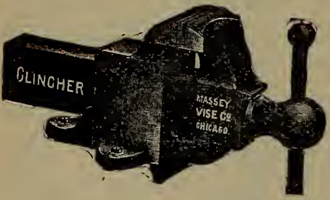
A trial will convince any one that these Shears will do the work easier and better than any Shears on the market that cost twice or three times as much. They are solid steel and fully warranted. Are equal to the best, and nearly as cheap as the cheapest.

WRITE FOR CATALOGUE OF FULL LINE AND TRADE PRICES.

CRONK HANGER COMPANY, - - - - ELMIRA, N. Y.

Our line for Sale by A. P. SHAPLEIGH HARDWARE CO.

MASSEY'S CLINCHER VISE.



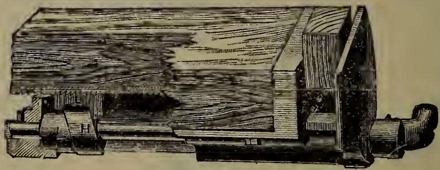
Flat Bott'm	Width of Jaw.	Opens.	Price
No. 30	3¼ in.	4 in.	$ 6 00
" 31	3⅝ "	5 "	7 00
" 32	4⅛ "	5½ "	8 50
" 33	4⅝ "	6¼ "	10 00
" 35	5⅜ "	8½ "	17 50
" 36	6 "	9½ "	25 00

SWIVEL BASES.

No. 30	$1 50	No. 33	$2 00
No. 31	1 75	No. 35	3 50
No. 32	2 00	No. 36	5 00

Discount..............................

MASSEY'S LIGHTNING GRIP WOOD WORKERS' VISE.



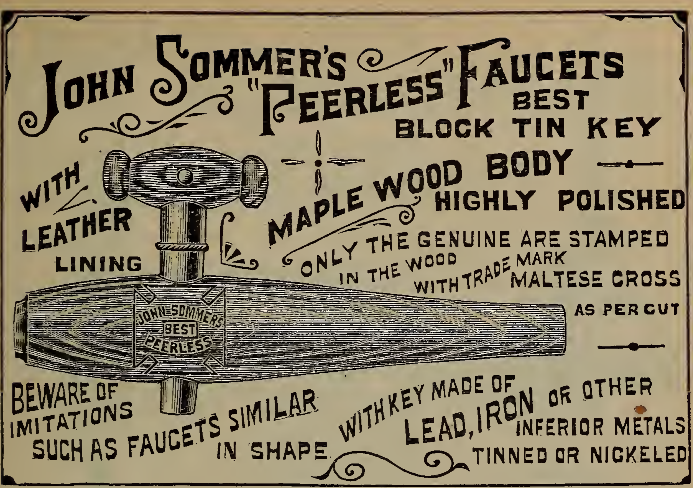
No. 17—9-inch Jaw. Opens 10 inches. Price, $6.00.

PLANER, MILLING MACHINE and DRILL PRESS VISES.

MASSEY'S.

Chucks the work instantly. Parallel with bed of vise.
The front jaw is adjustable to all shapes of work.

No.	Jaw, Inches.	Opens, Inches.	Weight, Pounds.	Depth of Jaw, Inches.	Price.
41	4	9¼	36	1¼	$15 00
42	4	9¼	42	2	17 00
43	5	11¾	65	1½	20 00
44	5	11¾	75	3	25 00
46	8	9½	150	2	45 00
47	8	11½	163	2	47 00
48	8	13½	176	2	49 00
49	8	15½	195	2	51 00
50	8	9	165	3	47 00
51	8	11	178	3	49 00
52	8	13	191	3	51 00
53	8	15	210	3	53 00



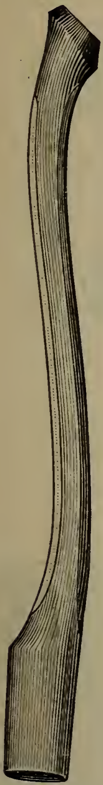
Nos....	0,	0½,	1,	2,	3,	4,	5,	6,	
Size...........	7,	8,	9,	12,	15,	18,	21.	24	inches.
Per doz......	$3.50	4.00	4.50	5.00	6.00	7.50	8.50	9.50	

Packed 1 doz. in box. 1 gross in case of 1 size.

No. 1, Size, 7 in.	No. 2, Size 8 in.	No. 3, Size 9 in.	No. 4, Size 10 in.
Per doz., $0.90	1.00	1.25	1.50

Packed 1 doz. in box. 1 gross in case of 1 size.

AMOS BROTHERS HANDLE CO.



POTEAU, - - I. T.

MAKERS OF ALL KINDS OF . . .

HAND SHAVED AND TURNED

HICKORY HANDLES.

We carry a complete line and solicit your orders for this make.

They Give Entire Satisfaction.

A. F. SHAPLEIGH HARDWARE CO.

SAINT LOUIS.

AUSABLE HORSE NAIL CO.

MANUFACTURERS OF

AUSABLE, CLINTON, AMERICAN, HOT FORGED and HAMMER POINTED NAILS.

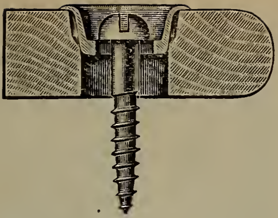
FOR SALE BY

A. F. SHAPLEIGH HDW. CO.

ST. LOUIS, MO.

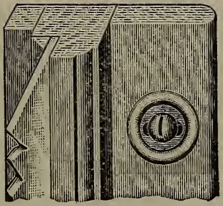
Can be applied to windows—old or new.

One winter's use will save their cost in coal bills.



CROSS SECTION OF STOP ADJUSTER.

Front View.



Back View.

Its Essential Features and Superior Advantages are:

1. This Adjuster is practically a flush Washer, and made from one solid piece of metal, with a thick bed that will not bend in tightening the screw, and a thin flange to admit of a close adjustment of screens, and also to prevent the screw from drawing it into the wood.

2. The solid ribs will drive into the hardest bead or stop, and prevent the Adjuster turning in either direction.

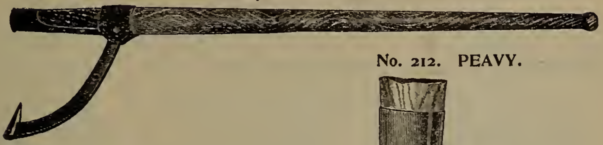
3. In appearance it is neat and ornamental, affording a quick and simple adjustment of the shrinkage or expansion of windows, doing away with unsightly weather strips and anti-rattler devices.

Ask your dealer to show you these goods.

For Sale by A. F. SHAPLEIGH HARDWARE COMPANY.

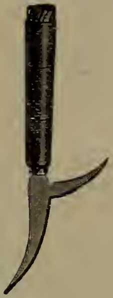
LOGGING TOOLS.

No. 246. CANT HOOK.

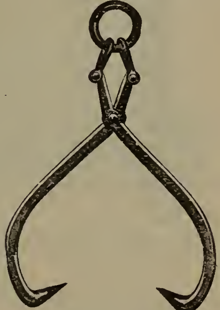


No. 212. PEAVY.

No. 260. PIKE POLE.



No. 286. SKIDDING TONGS.



No. 289. SWAMP HOOK.

THE COLUMBUS HANDLE & TOOL CO.

COLUMBUS, INDIANA.

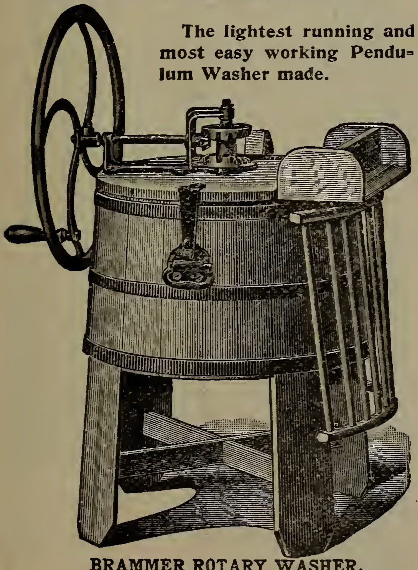
WRITE FOR CATALOGUE. For Sale by A. F. SHAPLEIGH HDW. CO.

THE EXCELSIOR PENDULUM WASHER.

The lightest running and most easy working Pendulum Washer made.

THE EUREKA WASHER.

☞ **A LIGHT RUNNING LEVER WASHER.**



BRAMMER ROTARY WASHER.

The Brammer

IS THE KING OF

Rotary Washers.

These MACHINES are **built** on **correct principles.** They are the result of 30 years' practical experience in manufacturing Washing Machines.

Being pioneers in the business, we have spent much time and money in an endeavor to build Washers that will combine **LIGHT RUNNING WITH THOROUGH WORK.**

EXCELSIOR MFG. CO., DAVENPORT, IOWA, Sole Manufacturers.

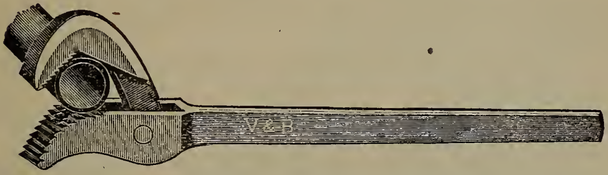
☞ Write us. **A. F. SHAPLEIGH HARDWARE CO.**

VAUGHAN & BUSHNELL MFG. CO.

——CHICAGO.——

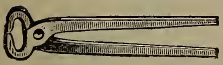
THE V. & B. PIPE WRENCH.

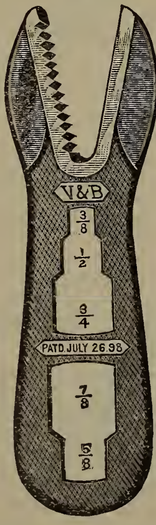
PATENTED.



☞The simplest and best Pipe Wrench on the market. Self adjusting. No springs or screws to break. Each Wrench takes many sizes of Pipe and Nuts.

☞WE MAKE FULL LINES OF THESE TOOLS.





Carried in stock by

A. F. SHAPLEIGH HARDWARE CO.

V. B. TOOLS are always the Highest Grade and Finish.

THE J. BARTON SMITH Co.

PHILADELPHIA, PA.

ESTABLISHED
——1842.——

The largest and leading American Manufacturers of the best quality

SHEEP AND HEDGE SHEARS

in great variety.

Our Shears are guaranteed to be equal in cut, temper and finish to the finest English makes.

☞We expect our Shears to give full satisfaction.

Ask for our Brand.

☞Fully Guaranteed.

Our

FILES

are made of the Best Silver Crucible Steel and GUARANTEED for cut, temper and wear.

FOR SALE BY
A. F. SHAPLEIGH
HDW. CO.

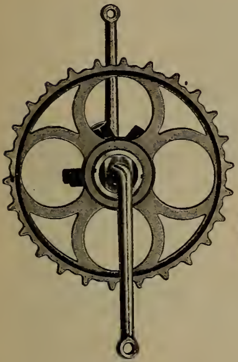
TOOLS and SPECIALTIES.

HALLADAY CRANK HANGERS.

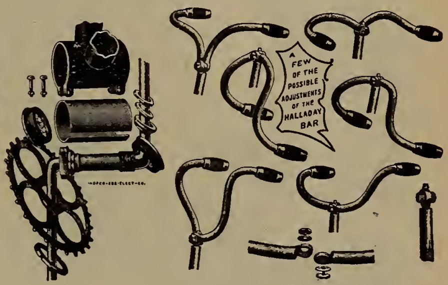
(ONE PIECE.)

INSTANTLY DETACHABLE FROM FRAME,

SIMPLY AND PERFECTLY RELIABLE.



WRITE FOR FULL DESCRIPTION.



Adjustable Handle Bars,

A POSITIVE MECHANICAL CONNECTION!
THE NEATEST CENTER-JOINT BAR MADE!

...MANUFACTURED BY....

MARION CYCLE WORKS,

MARION, INDIANA.

(WE ENDORSE AND SELL THIS LINE...

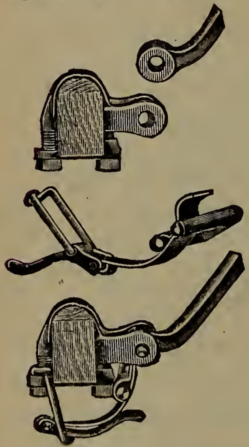
A. F. SHAPLEIGH HARDWARE CO.

THE FERNALD.

QUICK SHIFT AND ANTI-RATTLER.

..IMPROVED..

FERNALD QUICK SHIFT.

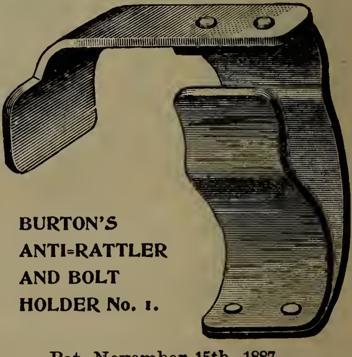


Patented June 13, 1899.
Canada, July 17, 1899.

Fits any Buggy, new or old. Can be attached and detached without the use of tools. The only practical Quick Shift that can be retailed for 50 cents per pair.

THE BURTON No. 1.

The Bolt Holder prevents the Bolt losing out in case the nut comes off the other side.



BURTON'S ANTI=RATTLER AND BOLT HOLDER No. 1.

Pat. November 15th, 1887.

We also manufacture the "Burton," Nos. 2 and 4 (this is the large size, $1\frac{1}{8}$ inch), "Fernald Wire," "Wire Drive," and "Gem" Anti-Rattlers, "Gem" Money Drawers, "Fernald" Lifting Jacks and Automatic Grip Neck Yoke.

FERNALD MANUFACTURING COMPANY,

NORTH EAST, PA., U. S. A.

SEND YOUR ORDERS TO US.

A. F. SHAPLEIGH HARDWARE CO.

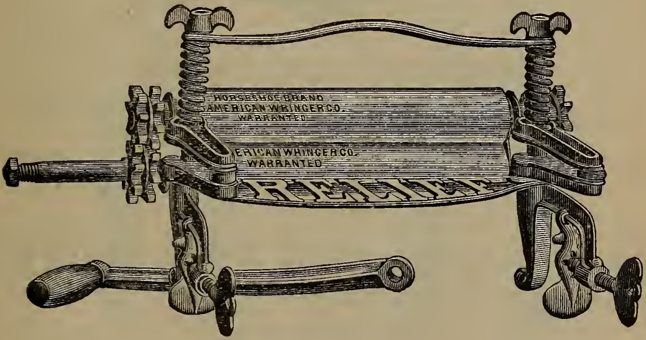
HORSESHOE BRAND HIGH GRADE

RELIEF

ROLLS WARRANTED FOR 3 YEARS

WRINGER

☞ REGULAR OR COMBINATION TUB CLAMPS.



REGULAR CLAMP.	COMBINATION CLAMP.	ROLLS.
330	C 330	10x1¾ inches.
331	C 331	11x1¾ "
332	C 332	12x1¾ "

PACKED 3 AND 6 IN A CASE.

For Sale by A. F. SHAPLEIGH HARDWARE CO.

ST. LOUIS.

EUREKA DIGGER CO.

—— MANUFACTURERS OF ——

IMPROVED POST HOLE DIGGERS

WE ILLUSTRATE THE "EUREKA" AND THE "ATLAS," WHICH ARE THE BEST ON THE MARKET.

EUREKA.

ATLAS.

THE EUREKA DIGGER has been thoroughly tested during the past 20 years in all parts of the country and has given perfect satisfaction.

The blades are made of the best cast steel; the castings are made of malleable iron and the handles of good white ash. The blades are 9 inches long and the length of the Digger 5 feet. Weight, 100 pounds to the dozen.

THE ATLAS DIGGER is the latest improvement. It is built after the principle of our celebrated Eureka Digger, the only material difference in construction resting in the double handles. These handles are so arranged that it is impossible for the operator to pinch his fingers while digging a hole. The **ATLAS** is one of the most powerful Diggers made, and it has the advantage over other "two-handle Diggers" because the arrangement of the hinges causes the blades to close without opening the handles very far, and this enables the operator to dig a hole almost equal in depth to the length of the Digger and retain a uniform size.

We solicit your orders. **A. F. SHAPLEIGH HARDWARE CO.**

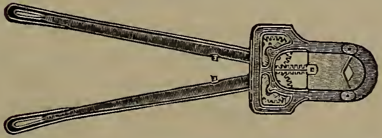
DR. LEAVITT'S LATEST IMPROVEMENT

the Screw Dehorner.

Leavitt Mfg. Co., Hammond, Ill., U.S.A.

Dr. LEAVITT'S

Double Power Dehorning Clipper!

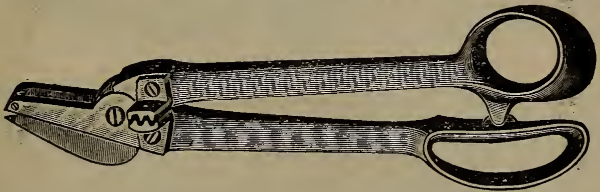


☞ IT CUTS ALL AROUND THE HORN. ☜

LEAVITT MFG. COMPANY, HAMMOND, ILL., U. S. A.

Carried in stock by A. F. SHAPLEIGH HARDWARE CO.

BERRIDGE'S PATENT PIPE SNIPS and PIPE CRIMPERS



Have no equal for Cutting and Crimping Stove Pipe, Conductor Pipe and Furnace Pipe. For Sale by Jobbers of Tinners' Tools and Sheet Metals.

☞Satisfaction guaranteed. Send for Circular.

BERRIDGE SHEAR CO., Sturgis, Mich.

Sold by A. F. SHAPLEIGH HARDWARE CO.

SEYMOUR MFG. CO.

RELIABLE MANUFACTURERS OF

GRAIN CRADLES

— AND —

SCYTHE SNATHS.

We carry this line in stock and solicit you orders. We have no complaint from customers when they specify SEYMOUR.

A. F. SHAPLEIGH HARDWARE CO.

PRATT'S HUSKING PINS.

Patented August 9th, 1898.

Made of the Best Cold Rolled Steel and Strap of Best Oil Tanned Leather.

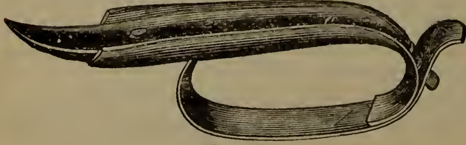
No. T 1.

No. T 1. The strap is provided with slots so it can be adjusted for the bare hand, glove and mitten. The guard and pad coming directly over the center of the index finger prevents wearing of the finger in case the ear is missed, and also prevents the Pin slipping back into the hand.

The strap is wide enough to protect the hand from the Pin, as when the hand is closed the strap bends over the edges of the Pin.

It is the most convenient Husker on the market. Can be worn over bare hand, glove or mitten without making a hole in the mitten. For mitten slip strap off of end and out of loop and back over end of Pin.

Two sizes; packed ¼ Gross in a Box.



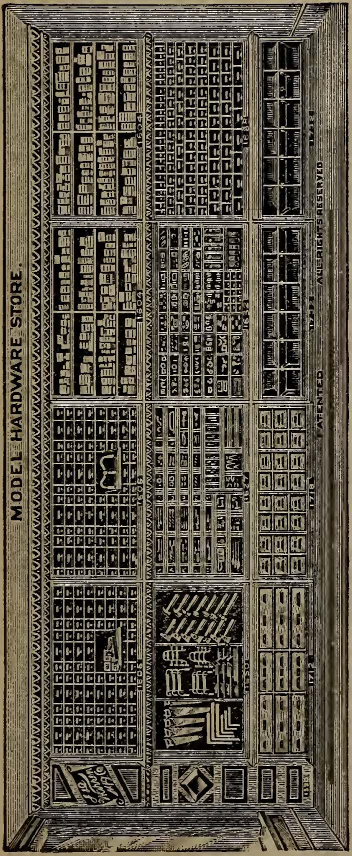
No. T 2.

No. T 2. An inexpensive but good, serviceable Husking Pin. Same as No. T 1, without steel finger guard, and strap made from the best inside split Oil Tanned Leather. Two sizes; packed ¼ Gross in a Box.

SEND FOR QUOTATIONS. A. F. SHAPLEIGH HARDWARE CO., ST. LOUIS.

WARREN'S PATENT

Glass Front Sectional Hardware Shelving.



Handsomely built of Antique Oak in interchangeable sections, each exactly the same length, height and depth; when set together they look and are perfectly solid, form uniform alignment, making a

Model Hardware Store.

Our new system classifies every line of goods separately — tools for the mechanic, builders' hardware for the contractor, and all shelf goods for the general customer. Displays samples of every article in plain sight of the buyer. Earns its cost in a very short time, and serves ever afterward as a Silent Partner and a blessing to the hardware merchant and customer.

Write to-day and learn how to make dull business bright.

J. D. Warren Mfg. Co.

MANUFACTURERS,

CHICAGO.

A Rare Combination

TRY OUR
"BALL BEARING"
SHEARS.

Quality,

Finish,

Cutting Power

Combined Only

in our

Products.

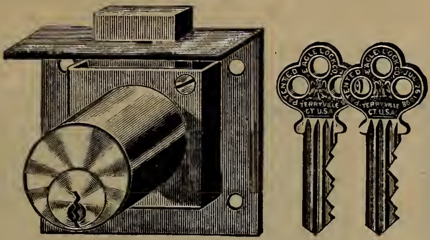
TRADE
Reliance
MARK.

Tailors' Trimmers' Tinners' Shears, Scissors, Snips.

The W. H. Compton Shear Co.

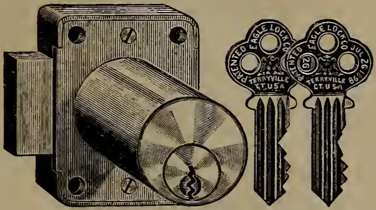
NEWARK, NEW JERSEY, U. S. A.

For sale by A. F. SHAPLEIGH HARDWARE COMPANY.



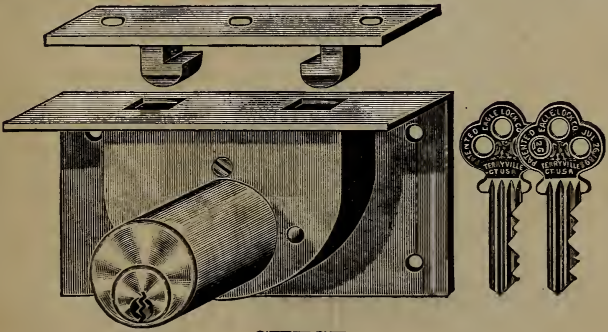
DRAWER.

No. 03210.—2¼ INCH, - $16.50. ALL BRASS.



WARDROBE.

No. 03121.—2x1½ INCH, - $20.00. ALL BRASS.



CHEST.

No. 03005.—4 INCH, - $32.50. ALL BRASS.

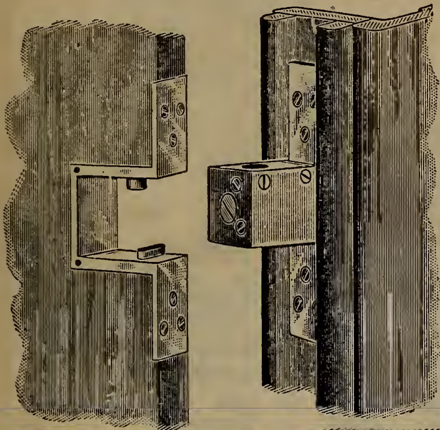
For Sale by A. F. SHAPLEIGH HARDWARE CO.

EASY SPRING HINGE COMPANY,

SHELBY, - - - - OHIO.

MANUFACTURERS OF THE

EASY DOUBLE-ACTING SPRING HINGE



The "Easy" Hinge combines all essential features in a first-class hinge. Will hold against a draught. Door cannot sag from the jamb. Air and dust-proof. Tension screw always in sight. Adjustment easy and quick.

As applied with Door and Jamb, with Face Plates removed.

Interior doors not exposed to strong draughts may be hung on half blanks, giving good, easy service, and more economical.

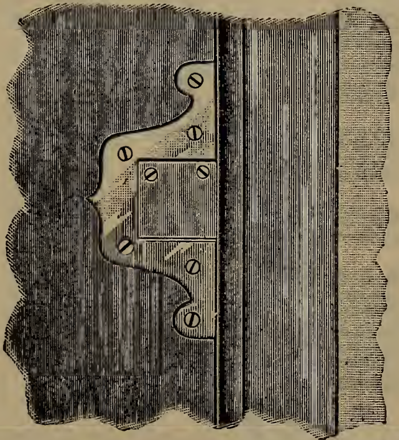
One pair in box, with Screws.

Japanned are not packed with Screws.

We recommend this HINGE.

Write us for prices and full particulars.

A. F. SHAPLEIGH HDW. CO.



Showing Hinge and Blank when the Door is Hung, with Face Plates attached.

THERE IS NO OTHER
FORCE,
BLOWER OR
DRILL
Anywhere near so Good as the Old Reliable
WESTERN CHIEF.
SOLD BY DEALERS EVERYWHERE
CANEDY-OTTO MFG. CO. CHI. H'GTS. ILL.

W 53